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The Effect of Context upon Perceptual Differentiation

BY

JOHN PORTER FOLEY, JR., Ph.D.

ARCHIVES OF PSYCHOLOGY

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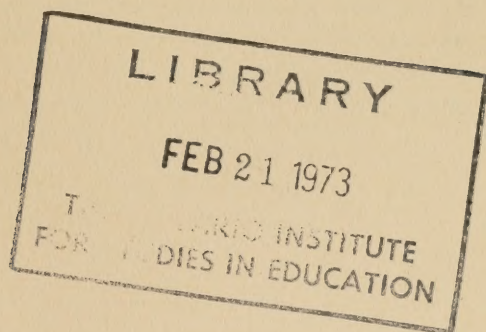
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The Effect of Context Upon Perceptual Differentiation

CHAPTER I

INTRODUCTION

The present investigation deals with the effect of context upon the perceptual differentiation of black-white visual patterns. In making perceptual reactions to the wide range and variety of stimuli with which it is continually confronted, the organism often "differentiates" or responds separately to certain portions or aspects of the stimulus situation. The present investigation represents an attempt to study the nature of the contextual factors influencing this differentiating process.

Although much has been written upon the general topic of part-whole relationships in the perceptual process, relatively little experimental work has been done on this problem, and most if not all of these investigations have been of an introspective nature. Philosophical speculation has abounded, frequently without the slightest nexus with scientific fact. Not only has there been a dearth of objective experimentation, but the problems upon which work has been attempted have been vaguely or incompletely formulated. Furthermore, the theoretical bias of many of the investigators has directed their attention to certain more or less superficial aspects of the problem, to the exclusion of the wider significance and implications of their own data.

The literature relating directly to the present specific problem is both meagre and scattered. The most relevant study is that of Hollingworth (26), although certain other investigations dealing with the developmental or experiential factors in perception have some bearing upon the problem. Most of this research has centered around the question of the nativistic versus experiential interpretation of perceptual phenomena. Only those studies which deal more or less directly with some aspect of contextual influence have been reported below.

1. HISTORICAL SETTING

The influence of experience upon perceptual phenomena has been investigated in a number of ways and with a variety of

stimulus situations. The general field of perceptual illusions, for example, has offered excellent opportunity for observation and research, and material has been obtained both of a descriptive as well as controlled experimental nature. Rivers (36), in his pioneer anthropological studies of the Todas of Southern India and groups inhabiting certain of the islands of Oceania in the Torres Strait region, has reported interesting and significant data concerning the perceptual reactions of such primitive peoples to the Müller-Lyer illusion. Using a method requiring the adjustment of a variable sector of the figure until it was subjectively equal to the other standard sector, Rivers concluded that the illusion was slight or practically non-existent in the Murray Islanders. The Todas, however, experienced the illusion to a somewhat greater degree, although still slightly less than the average English observer. In the *Torres Strait Reports*, he suggests that the reason for the "slighter degree of the illusion to the savage observer" was the fact that "the savage . . . concentrates his attention more completely on the two lines which he is told to make equal and is less influenced by the figure as a whole."

Not only did Rivers fail to note why such behavior might be differentially characteristic of the "savage" observer, but his subsequent experiments on the Sholagas and Uralis, Indian jungle tribes, showed that although these people were in a state of culture quite as primitive as the Murray Islanders, they nevertheless experienced the illusion more strongly than any other group tested. It is also interesting to note that Rivers found the vertical-horizontal illusion to be distinctly more marked among both Todas and Papuans than among the European subjects. Fortune* has observed that the Melanesians commonly use arrow-shaped spears and Y-pronged forks as implements and weapons, and has suggested that behavioral familiarity and constant interaction with such geometrical forms may account for the reduced prevalence of the Müller-Lyer illusion in such Melanesian culture. These data are cited as but one of the many fruitful anthropological observations regarding the effect of experience or cultural conditioning upon perceptual phenomena. It is unfortunate that more utilization has not been made of the various anthropological data obtained with regard to the patterning of behavior in different cultural milieux. Although it is doubtless true that many of such data are anecdotal in character, they nevertheless illustrate the widest

* Fortune, R. F., in a personal communication to O. Klineberg.

variety of reactions to frequently identical stimulus objects and events, and as such deserve far more consideration by psychologists than they have heretofore received. The writer (11) has elsewhere called attention to the limited scope of most psychological perspectives, and nowhere is this fact better illustrated than in research on and interpretation of perceptual phenomena.

Crosland, Taylor, and Newsom (6) have studied the problem of intelligence and susceptibility to the Müller-Lyer illusion. In 25 subjects no significant relationship was found between scores on an intelligence test and susceptibility to the illusion. Six different modes of presentation were used, and the average correlation coefficient between intelligence test score and amount of error occurring in these different modes was $-.086 \pm .13$. Definite practice effects were found in the two subjects in whom this phenomenon was investigated.

In a further study dealing with practice and improvability in the Müller-Lyer illusion in relation to intelligence, the same investigators (7) obtained the following results on 33 subjects: (1) no significant correlation between intellectual rating and susceptibility to error in the perception of the lines, regardless of whether that error was measured as the initial error, the mean error of 30 daily trials, or the final error, (2) a very slight suggestion of a possible positive relationship between high intelligence and low error in the illusion, (3) definite practice effects over a period of 30 daily trials, involving an initial decrease of error less rapid than usual, followed by a gradually lessening amount of error from then on, (4) no significant correlation between intellectual rating and amount of improvement resulting from practice, (5) initial ability was slightly and positively prognostic of final ability, such prognostication, however, being relatively hazardous, and (6) subjects of higher intelligence tended to over-correct the illusion figure in the late stages of practice, while subjects of lower intelligence tended to under-correct the figure even after they had had a large amount of practice.

The importance of context in the perception of illusion has been experimentally demonstrated by Zama (43). Using the optical complexes of Gatti, Zöllner, Hering and others, habitually seen with illusory deformations, Zama resolved such complexes into two groups of elements, each of which appeared without deformation. The two separated groups of each complex were then presented stereoscopically to the observer, and it was found that the

fusion of the two parts reconstituted the complex and caused the illusion, just as when the entire complex was seen under natural conditions.

The rôle of context has been further emphasized in a study by Gatti (17) on illusions in the perception of geometrical figures seen at rest and in motion. When such space relations appear in the parts of a complex, they become changed or "deformed," and this phenomenon has been termed by Gatti the "deforming nature of the complex."

Numerous investigations have dealt with the effect of various factors on illusions of reversible perspective. Donahue and Griffiths (8), for example, studied the influence of complexity on the fluctuations of such figures, using 8 well-known figures of the reversible perspective type, such as the "staircase," "cube," "glass," "book," "tetrahedron," and various composite "cube" figures. They found that the greater the complexity of the figure, the slower the rate of change, but that this factor of complexity is not the most important. The most important factor was found to be the familiarity of the subject with the figure and with the two possible interpretations. The more familiar the figure, the more rapid was the rate of fluctuation, unless there was an unequal familiarity with the two interpretations of the figure.

Similar results on the comparative controllability of the fluctuations of simple and complex ambiguous figures have been obtained by Washburn, Regan, and Thurston (39). The results of an experiment on voluntary control of the phases of the "book," "staircase," and "cube" figures showed that the ability to control the phases rests on two factors: (1) simplicity, and (2) frequency, or practice. The investigators concluded that those phases which are simplest and most familiar in daily life are easiest to hold dominant.

From the above studies it is evident that practice or experience plays an important rôle in the perception of illusory figures. The way a given form is perceived or behaviorally "patterned" is determined not by some ultimate and inevitable organization of its physical parts, but rather by the manner in which the individual has learned perceptually to respond to it from time to time. The stimulus is always patterned, to be sure, but the patterning itself can be most adequately described by reference to the reactional biography of the individual observer.

An attempt to study the effect of practice on the perception of indistinct visual forms in a limited practice situation was made

by Seward (37). A preliminary experiment on 6 subjects, using pairs of nonsense syllables to be read behind ground glass in varying illuminations, showed continuous improvement through 12 days of practice. In the main experiment, in order to simplify the conditions of learning, the experimenter presented for identification single letters behind ground glass in constant illumination. Seven subjects served for 3 days of preliminary adjustment and 12 days of recorded practice. In general it was found that practice was attended by gradual improvement throughout the course of the experiment.

Reymert (35) has investigated the ontogenetic aspects of "meaning" in a group of 300 children, ranging from 5 to 14 years of age. The subjects, examined in individual sittings, were first shown a white card containing a 60° angle drawn in black, with the questions, (1) What is this? What does this mean to you? and (2) How do you know? Why does it mean that to you? Three series (5 lines of varying thickness, 5 angles differing in position, 5 angles differing in inclination) were then presented with the aim of throwing light on the bearing of attributes such as size, position, etc., of simple geometrical designs on meaning. Among the conclusions most relevant to the present study are the following: (1) Meaning seemed to be derived entirely from and to be built up by experience. (2) Meaning springs from a context, a gross pattern or phenomenological situation, almost invariably colored by pleasant emotional content. (3) The same stimulus may give rise to almost any meaning, and this meaning is often independent of attributes of the stimulus like position, size, etc. Meaning thus did not seem to reside in the stimulus, but rather in a relation between the stimulus and response, of a phenomenological nature. (4) Such relationships are very unstable in young children, but with advancing age and homogeneous training they tend to become more stabilized and uniform.

Ehrenstein (10), in an attack upon the problems of figure and ground, reports tachistoscopic experiments made to determine the duration of exposure necessary for a figure to become perceptible. This duration was found to vary with illumination, distance, size, and internal contrasts. The influences which were effective differed according to whether a simple colored form (circle) or a complex figure (letter) was used. Finally, the duration varied with the degree of meaning or significance of the figures involved.

Gibson (21), in an investigation on the reproduction of visually perceived forms, undertook to study the variations in the reproduction of geometrical patterns shown tachistoscopically to observers, and to relate the difference to the observer's reports upon the nature of perception. Two series of simple geometrical figures were used as material, the one series consisting of 14 figures made up of straight lines, and the other, 14 figures made up of curved lines, including 4 figures that involved both straight-line and curved-line components. The figures, $\frac{7}{8}$ -inch in diameter, were exposed by means of a modified Ranschburg memory apparatus for a period of approximately $1\frac{1}{2}$ seconds. Six observers were employed, making approximately 4,000 reproductions of the 28 figures. An analysis of the types of changes introduced by the observers showed trends in the direction of making them similar to objects frequently associated with the figures in previous perceptions. Changes were also found to be conditioned by cues furnished from a verbal analysis made during the perception of the form. So-called closure, or perceptual filling, and analysis, or falling apart into separate units, were also noted in certain cases. Gibson has interpreted the changes observed in the experiments as evidence for the existence of perceptual habits which have arisen in the individual during experience.

A similar tachistoscopic study of the differentiation of perception was performed by Bridgen (2), who investigated the changes observed in simple drawings with reference to the problem of how differentiation occurs in a homogeneous perceptual field. Four groups of subjects reproduced the drawings under different conditions of exposure time; and it was found possible to classify five types of changes in the reproductions: simplification, complication, completion, transposition, and increased symmetry. From the data on accuracy of reproduction in relation to exposure time, Bridgen concluded that under the conditions of the experiment, "perception involves the differentiation of a homogeneous field in such a way that the parts emerge already unified and patterned."

Netschajeff (33), investigating the question of the so-called qualitative forms of perception, has employed a tachistoscope permitting the presentation of real objects. In the experimental series 5 objects were usually presented, each representing a different kind of interest, *e.g.*, domestic, religious, artistic, etc. Minimal exposure time was given first, and then this was gradually lengthened. Whenever an object was reported seen, the same ex-

posure time was immediately repeated. It was found that three general kinds of perception might be isolated: (a) objective—gradual acquisition of a perception, without any illusions; (b) illusory—illusions continually observed for some time; and (c) indeterminate—quickly rising and quickly disappearing illusory perceptions. Netschajeff further concluded that the inclination to the “objective” form of perception increases with the age of the observer, and simultaneously the tendency to illusions decreases.

An entirely different approach is furnished by the work of Brunswik (3) on the influence of intentional attitude and practice on Gestalt constancy. Geometric forms were presented in 4 planes other than at right angles to the subject’s line of vision, and judgments were obtained as to the apparent shape of the object as compared with a standard form. Five subjects were used on 13 different days. It was found that the attitude assumed by the subject resulted in relatively large changes in the Gestalt constancy, and practice increased the changes thus brought about. In a further genetic study of Gestalt constancy, Brunswik (4) utilized 18 age groups, each composed of 16–20 subjects of both sexes; and these groups were tested by the technique described above. The resulting age curve showed a fairly regular increase in Gestalt constancy from ages 3 to 14, which falls off rapidly and reaches the ninth year level for the 18-year-olds and adults 19 to 30, and finally drops to the eighth year level for adults 30–70 years of age.

Drury (9), in a study of progressive changes in the non-foveal perception of line patterns, has attempted to trace the genetic development of the perception of such peripherally presented patterns in adults. A series of 12 line-patterns was presented at 4 extra-foveal places, avoiding the blind-spot, by means of the Hellpach perimeter. The exposure time was 100 σ , and no design was presented twice in succession. The observer was required to draw what he saw. In all cases the original perception was found to be vague and uncertain, whereas the end-product was stable, though not necessarily correct. The accuracy of the end-result depended upon the observer. Self-instruction was found to reduce the amount of error.

An effort to go beyond the mere stated existence of a Gestalt or particular patterning of perceptual behavior has been made by Chou (5), who attempted to explain former findings to the effect that adult Chinese readers always read downward the faster. Chou maintains that just as, in Western languages, the word-Gestalt is

less distorted by reversing the line as a whole than by reversing the letters individually so, in Chinese, an analogous sentence-Gestalt is the temporo-spatial sequence of individual characters in line irrespective of reading direction or character position. The traditional downward arrangement of characters has established in adult Chinese readers a downward reading pattern. Likewise, the greater speed of leftward reading found in Chou's experiment, is explained by original Chinese usage establishing this Gestalt.

A large number of experimental investigations into the phenomenology of perception have appeared from the Sacred Heart University of Milan, in accordance with the conceptions expounded by Gemelli and his colleagues. By means of the general method of peripheral visual stimulation in what they term the "functional analysis of perception," Gemelli (19, 20) and Galli (13) have concluded that meaning is the fundamental element in the "construction" of a perception, as well as its final element, since it serves to "complete" the perceptual act. They furthermore maintain that the "organization" of the sensorial data takes place by passing from the indeterminateness and vagueness of the single sensorial datum to the "construction" of the object perceived. Similar results concerning the developmental stages of the perception of nonsense forms (ink blots) have been obtained by Freeman (12). The more relevant of the Italian experiments may be briefly mentioned, although Gemelli and his coworkers, after stating that "meaning" and "objectification" play the dominant rôles in perceptual reaction, immediately dismiss the matter and fail to state just what determines or conditions the meaning and objectification. One problem is answered in terms of another, for the mere naming of a perceptual process in no way reveals the nature of the underlying mechanisms.

In a series of studies on the perception of regular geometric figures masked wholly or in part by other geometrical figures, Galli and Zama (14, 15, 16) have further attacked the problem of form perception. A series of figures was employed in which a simple geometric form was wholly or partially covered by other more complex forms, and the subjects gave their reactions after viewing each figure. Further evidence was found to substantiate Gemelli's theory as to the primary importance of meaning and abstraction in the final determination of the perception of a complex group of sense data. One figure could conceal another only if it was more "pregnant with meaning," or if its parts formed a "more unified

structure." The more meaningful figure often appeared larger or with a stronger designation of lines, than the obscured less meaningful figure. Contrary to the Gestalt view, Galli and Zama (14) maintain that the form is not a simple datum, but that it elaborates itself into a meaningful unity. Further description as to how this "meaning" is acquired is not offered.

Gemelli (18) has further emphasized the fact that in actual life we do not merely perceive forms, as seemingly indicated by many of the studies with geometrical figures, but we normally perceive objects. By means of a cinematograph the experimenter presented changing designs that were similar to animated films, and then analyzed the introspective reports of his observers who were reacting under various definite instructions. Four phases in the perceptual process were evidenced: (1) mere presence of an object; (2) rise of a configuration or uniform organization; (3) perception of the meaning of the object; and (4) verbal naming. Gemelli maintains that the experience of meaning is distinct from the perceptual organization, being the basic element in the perceptual synthesis.

Wertheimer (40, 41) was among the first to utilize the hidden-figure type of experiment, and this technique has been most widely used by Italian and German investigators. Wertheimer concealed familiar forms, such as letters of the alphabet, in complex configurations, and found that it was often difficult to see the letters even when the subject knew of their presence. He concluded that past experience was ineffective, since the letters presumably were more favored by past experience than were the complex and relatively strange configurations in which they were concealed. Köhler (30, 31) has presented similar evidence against what he conceives to be the experiential interpretation of such perceptual phenomena.

The best known of the Gestalt experiments of this type, however, are those of Gottschaldt (22, 23). In an experiment on the influence of experience and habituation upon the perception of figures, Gottschaldt (22) exposed a simple figure from 3 to 500 times, and then showed a complex figure which involved the simple one in its pattern. In the main series of experiments 5 outline figures were used as impression forms, and 31 complicated geometrical patterns were employed as test figures. The impression figure was concealed by various means such as by employing only a part of its contour as the contour of the dominant form within the new complex, or by covering it with several lines which formed

another pattern. It was found that with no instructions to look for the simple figure, it "sprang out" in less than 2 per cent of the cases, and instructions to look for the figure failed materially to increase the per cent. When a continued search was made for the simple figure it was found in only 19 per cent of the cases. Thus it was concluded that the total figure asserted itself and effectively obliterated the identity of the parts, and past experience was of little consequence.

In a further study on the effect of figural impression and the influence of specific sequences of events on the comprehension of visual complexes, Gottschaldt (23) presented several series of geometrical figures, the figures in each series containing common elements. Thus, for example, in one series there was a simple Y-figure, then a second Y in which the tail transected and equaled the height of the two arms, forming three prongs, and a third Y in which the two arms were joined by a straight line, forming a deltoid figure with a tail. In this series, even when the simple Y had been initially presented 40 times before the others, the second and third figures were seen as simple configurations and not as a Y with something added. These results were also interpreted as antithetical to the experiential determination of the perception of visual complexes.

Suzurki (38) has reported similar experiments on the influence of experience on the visual perception of figures. Nine test figures, with their component and relatively simple impression figures, were presented to small groups of 3-4 subjects each. In no case did the small figure "stand out," and it was subsequently found in 14-30 per cent and "surmised" in only 10-23 per cent of the cases.

Braly (1) has also investigated the rôle of past experience by determining the influence of the preception of certain visual forms upon subsequent perception of other visual forms. The procedure consisted of repeated tachistoscopic exposure of geometrical forms of a given type as an impression series, followed by a test series consisting of additional geometrical forms of different types interspersed with the initial ones. The forms were composed of arrangements of dots representing triangles, quadrilaterals, and pentagons, and the subjects drew the figures which the dots appeared to form. Both experimental and control groups were employed, the former receiving both impression and test series, and the latter receiving only the test series. In general it was concluded that (1) the presentation of a particular type of figure in a short impression

series noticeably influences the reports of succeeding figures; (2) the effects of the impression series are specific to the particular type of figure used in that series; (3) simple figures vary considerably in the difficulty with which they are perceived; and (4) the extent to which past experience is effective varies according to the particular figures employed as impression and test figures, and is definitely related to the degrees of perceptual difficulty of the figures.

Moore (32) has criticized the work and interpretations of Gottschaldt who, after finding that numerous repetitions of a figure did not enable an observer to find it more quickly when it was concealed in a subsequently presented ensemble, concluded that experience is insufficient to overcome the autochthonous Gestalt factors. Moore objects particularly to the further conclusion that "of the great original claims of the empiricists very little is left," for he clearly points out that Gottschaldt has nothing to say regarding the genesis of the autochthonous Gestalt factors. Moore further maintains that the previous experience of the observers has dealt with the figures in isolation, and not woven into a bewildering fabric of lines and angles and cross-hatchings. He expresses the view that the method of submerging the impression figure in the test pattern demonstrates little more than the methods by which similarity to the isolated figure may be destroyed.

It would seem that Moore's criticisms are thoroughly justified. As has been pointed out above, the patterned or meaningful characteristic of a stimulus situation has, to the writer's knowledge, never been questioned. The real issue, however, is in regard to the factors which account for such patterning, and it is here that the Gestalt psychologists have usually dropped the question. The implicit assumption, throughout, has been that such configurational properties are innately determined, although the bulk of the evidence has undoubtedly been in favor of the experiential determination of such perceptual patterning.

Not only are Moore's objections to the anti-experiential interpretations drawn from the use of this technique perfectly valid, but careful inspection of the figures employed will show that the results may quite reasonably be interpreted as proving the influence of experience. By "experience" or "practice" Gottschaldt referred to the 3-500 presentations of the impression figure, and totally neglected the fact that complexes similar to the test figure had been seen hundreds of thousands of times more, as well as at an earlier ontogenetic stage than, the impression figure. Inspection of the

test figures of Gottschaldt (22, 23), Köhler (31), Wertheimer (41), and Suzurki (38) will show that they represent a modified cross, a wire screening, or sometimes merely two enclosed forms, as in Köhler's celebrated figure 4 complex. From birth the individual has reacted perceptually and otherwise to closed forms, such as books, vases, oranges, pictures, and almost every object one can think of, so that objects whose retinal patterns present this common characteristic have acquired a prepotent function in this regard. The reader should bear this fact in mind when the results of the present investigation are discussed in following chapters.

The study most relevant to the present investigation is that of Hollingworth (26) on the conditions of verbal configurations. The hypothesis to be tested involved the assumption that words could be built from letters more readily or rapidly if these letters did not already constitute a word than if they were already part of a meaningful configuration. A brief and interesting short story was first constructed, and 25 words of the story were "disarranged" in the following fashion: Form A contained disarranged words of which the jumbled letters did not "make sense" (*e.g.*, "intellectual" appeared as "alinletluetc"); Form B contained the same disarranged words of which the jumbled letters formed another meaningful word or phrase (*e.g.*, "intellectual" appeared as "allinlettuce"). The subjects were given a fixed time to correct the story by simply supplying for each disarranged word the letters in their correct form. A group of 100 female subjects, half taking Form A and half Form B, failed to show an average difference in score between the two forms.

Hollingworth then sought to simplify the conditions by eliminating the story with its distractions and contextual suggestions. A list of 50 names of familiar animals, such as oyster, tadpole, grasshopper, etc., was prepared. Again two forms were constructed: in Form A the letters were disarranged so that they did not constitute a word; in Form B they were disarranged in such a way that they formed words or word pairs, but not the names of animals. Thus in Form A the animal "tadpole" appeared as "lpae odt," whereas in Form B this animal appeared as "leap dot." Other rules were applied, such as keeping a given letter in the same relative part of the total combination in both cases, and breaking the meaningless group of letters into two parts if the meaningful arrangement took the form of two words. Neither

Form A nor Form B, as described, was used, but derived Forms C and D were prepared for actual use. Each contained the entire 50 names or arrangements, half from Form A and half from Form B, in regular alternation, so that the word appearing one way in Form C was shown in the opposite way in Form D, and vice versa. Thus the two forms served as mutual controls, and were combined in the final results, although any given individual was given but one form. Ten minutes were allowed for each form.

Hollingworth's results showed no consistent relation between Army Alpha score and the number of words built by the subjects. A more relevant and important index was derived from the number of words built from "configured" and "unconfigured" letters. Analysis of separate subgroups gave inconsistent results, and when all available cases were combined it was found that in Form C (115 cases) the average* number of words built from configured letters was 5.1, whereas from unconfigured letters the average* was 4.7; and in Form D (79 cases) the average number of words built from configured letters was 3.7, while from unconfigured letters the average was 4.5. Thus the two forms give opposite results, and there appears to be no conclusive evidence supporting the conception of a word as a constraining Gestalt. Ratios of configured to unconfigured scores were also computed for each individual subject, and again the results were inconclusive. It seems possible to the writer that one reason for such negative results was the lack of "set" on the part of the experimental subjects. Since configured and unconfigured material was alternated within a given form in this part of the experiment, any "set" or attitude to perceive meaning would undoubtedly have been minimized or completely disrupted. When the subjects were classified into 6 groups on the basis of their Alpha scores, the median ratio of configured to unconfigured scores indicated a tendency for those making lower Alpha scores to be more handicapped by the presence of the meaning configuration. When, however, the subjects were divided into 3 more general and inclusive groups on the basis of Alpha scores, this apparent trend disappeared. It seems, therefore, as Hollingworth points out, that the relationship suggested was entirely unreliable. It might be added that this lack of relationship may have resulted partly from the fact that the Army Alpha is not well suited to college students and does not discriminate sufficiently at this level.

* Computed by the writer from Hollingworth's data.

2. THE PRESENT PROBLEM

The present study was a direct attack upon the influence of spatio-temporal context upon perceptual differentiation. The writer was of the opinion that the various data on this problem reported by investigators of different "schools" were actually not at variance, but that the chief difficulty was in the faulty interpretation of certain experimental findings, as in the case of most of the so-called anti-experiential results of the Gestalt school. Furthermore, data on these problems, such as the oft-quoted question of the "nature of the 'part' being determined by the nature of the 'whole,'" have usually been obtained only indirectly or inferentially. Finally, most, if not all, of the previous experiments have relied largely upon the subject's introspective report or description of his observations for their crucial data. Thus it was decided to attack the problem as directly as possible, and to set up the experimental situation in such a way that simple, direct, and quantitative indices might be obtained.

It was finally decided to employ a form of code substitution situation in which, by reference to a key, the subject was to substitute numbers for small squares composed of simple black and white surfaces. These stimulus squares were arranged into a variety of visual patterns, so that the subject had to "differentiate" or perceptually analyze such patterns in making the correct substitution. In two of the sheets, the designs so constructed were meaningful pictures; the other two sheets contained meaningless control designs, derived by disarranging the squares of the original designs according to given rules. By "meaningful" designs is meant patterns that may be readily taken to represent common objects, such as a chick, dog, gun, etc. By "meaningless" designs is meant patterns that are not representations of such named objects. The former are conventionalized pictures, whereas the latter are mere irregular and unnamed forms. This is not to deny, however, that the latter may possess meaning of some sort, as will be discussed further in the *Theoretical Interpretations*. When practice effects were ruled out, it was hoped that a comparison of the differences in the number of substitutions made with the two types of material in a given time would reveal the effect of context upon the process of perceptual differentiation. A considerable difference was found, and such data, together with their accessory conditions, constitute what hereafter has been designated Experiment I.

Upon detailed and critical examination of the materials and results of Experiment I, however, it was noted that the control or derived forms possessed a lesser degree of "compactness" of black or white surfaces than did the more meaningful forms. Thus it was apparent that such results might have been due to the relative meaningfulness of the forms or to the differences in black-white organizations between the two types of material. Either or both of these factors might have been operating. Experiment II was therefore devised to answer this question. A large sheet of "compact" meaningful designs or pictures was employed, together with a derived sheet of meaningless and relatively less "compact" designs, as in Experiment I; and to these was added a third sheet of meaningless but "compact" designs, formed by simply inverting the designs in the original meaningful sheet. For the sake of convenience the distinction will hereafter be made between meaning, or conventionalized representation of named objects, and "compactness," or degree of adjacent arrangement of similarly colored surfaces. In the *Theoretical Interpretations*, however, it will be suggested that the factor of "compactness" is possibly itself of a meaningful or experiential nature. After elimination of practice effects through the method of rotation, the differences between scores on these three different forms would thus throw light on the effect of the various types of context upon the process of perceptual differentiation.

Experiments I and II will be discussed independently below. Since the subjects, materials, and procedure differed in the two cases, these details will be discussed separately in connection with their respective experiments.

CHAPTER II

EXPERIMENT I

The data of this experiment were collected during the academic year 1933-34.

1. SUBJECTS

The subjects* employed in Experiment I were 126 female students, all of whom were enrolled in psychology courses at Barnard College, Columbia University. The group was relatively heterogeneous with respect to both age and socio-economic background, although necessarily somewhat selected with respect to "intelligence." The subjects ranged in age from 15 years, 11 months, to 22 years, 7 months, with an S.D. of 17.2 months, and a mean age of exactly 19 years. The range in "intelligence" test scores, as determined by the Scholastic Aptitude Test of the College Entrance Examination Board, was from 726 to 1490, with an S.D. of 133.1, and a mean of 1006.2. These scores were determined by adding the scores on the verbal and mathematical parts of the test. The intellectual status of this group in relation to other groups of the same educational level is shown by comparison of these scores with those given in the Ninth Annual Report of the Commission on Scholastic Aptitude Tests, 1934 (34). Addition of the mean scores made on the verbal and mathematical parts of the test by girls actually admitted to colleges yields a total mean score of 965, which will serve as a norm for evaluating the present group. It was decided to employ these scores since they furnish a more thorough and reliable index of "intelligence" at this level than any test which might have been administered within a single class period. From such a comparison it seemed justifiable to suppose that the present subjects would be well suited for the investigation of relatively complex perceptual phenomena. The division of the subjects into experimental groups and the more specific characteristics of such groups, will be discussed below.

2. MATERIALS

The materials used in Experiment I consisted of four separate sheets of designs, two of which, Forms A and B respectively, con-

* Exclusive of preliminary subjects.

sisted of 12 pictures of *meaningful** objects, and two of which, Forms C and D respectively, consisted of 12 *meaningless** or non-sense designs. These four sheets of experimental material have been reproduced in reduced form in Figures I and II.

At the top of each experimental sheet was a key composed of six different stimulus squares, each $\frac{1}{4}$ inch square, and each paired with a number from 1 to 6. The numbers were $\frac{1}{4}$ inch high, and were clearly printed approximately $\frac{1}{12}$ inch below their respective squares. The stimulus squares themselves were arranged in a horizontal row, $\frac{1}{2}$ inch apart, and varied only in the relative amount and position of the constituent black and white surfaces. Thus, for example, square 1 had the lower left-hand corner black and the upper right-hand corner white, square 2 was entirely black, etc.

Directly below the key, beginning with the upper left-hand corner of the sheet and progressing from left to right within each row, were 12 stimulus designs, three rows of four designs each. Each of these figures was exclusively constructed from the six small squares in the key, the difference in the characteristics and appearance of each design being accomplished through different serial arrangement and juxtaposition of the component squares. The four designs in the first row of each sheet were made up of 16 squares, 4 rows of 4 squares each, whereas those in the second and third rows contained 25 squares, 5 rows of 5 squares each. Thus the designs in the first row were 1×1 inches, whereas succeeding figures were $1\frac{1}{4} \times 1\frac{1}{4}$ inches in dimension.

Approximately $\frac{1}{4}$ inch below each stimulus design, and situated alternately to the left or right within each row, was a composite set of small white squares or reaction spaces, each corresponding exactly in size and conformation with its respective stimulus design above. In these blank spaces, each $\frac{1}{4}$ inch square, could be written the particular number associated with the square in the corresponding portion of the stimulus design. Not only were such reaction spaces alternated from left to right in relation to the respective stimulus designs above, but a given vertical column of reaction spaces, regardless of its position, was never directly below any vertical column of squares in the stimulus design, *i.e.*, the squares comprising the reaction spaces were always to the left or right as well as "out of line" with the squares in the stimulus design. These devices precluded the possibility of simple division of the design on the part of the subject by mere upward projection of

* Cf. Chapter I for the use of these terms in the present study.

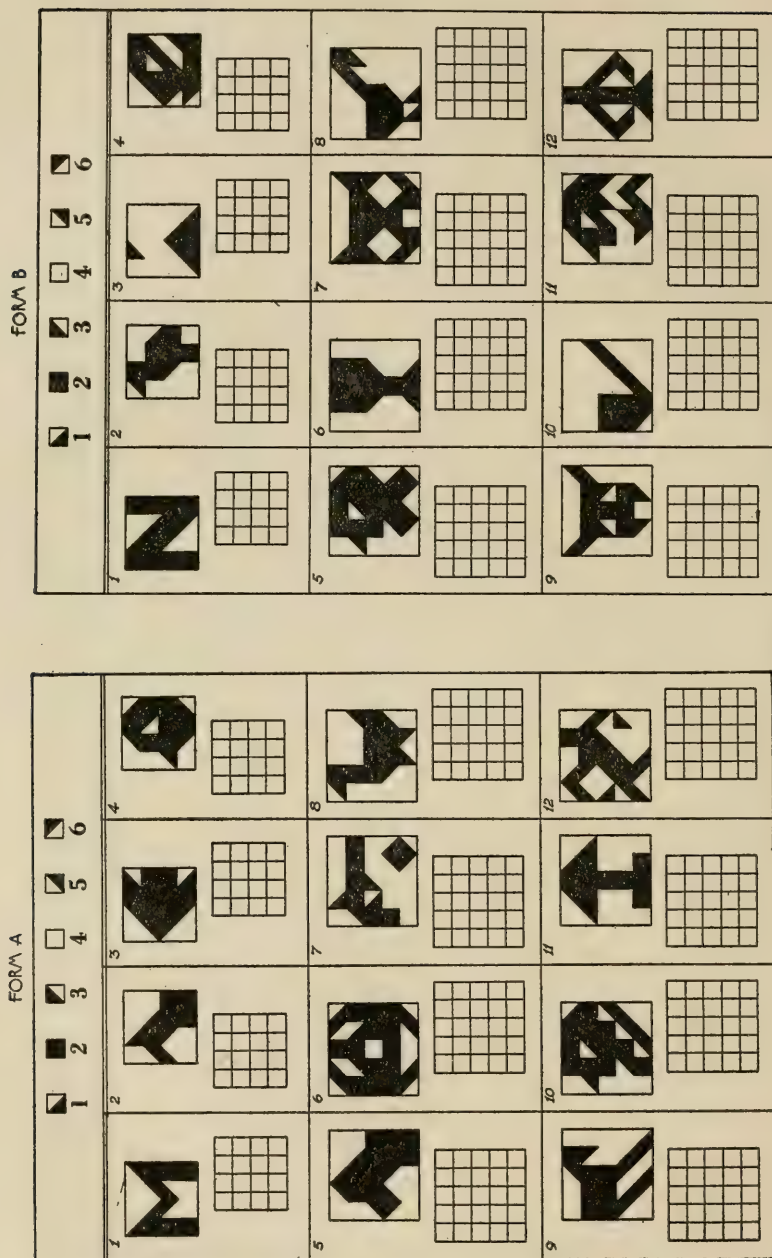


FIGURE I
Forms A and B employed in Experiment I
(Reduced to 38% of original size)

the lines forming the vertical boundaries of the columns of reaction spaces. Thus artificial aids were minimized in the process of perceptual differentiation.

As stated above, Forms A and B were exclusively composed of *meaningful* designs, such as pictures of a letter, arrow, gun, glass, pipe, lamp, or the face, head, or body of a man or animal. Forms C and D, on the other hand, were *meaningless*, and were constructed in the following manner. From a given meaningful design, the first horizontal row of squares was taken and utilized as the first horizontal row of a corresponding meaningless figure. The remainder of the horizontal rows of the meaningful design were then rearranged vertically in any fashion so as to form the remaining rows of a relatively meaningless or nonsense figure. Thus the squares comprising any meaningful figure were identical to those comprising the control or meaningless design, the first rows of the two figures being exactly the same, and the sequence within any given horizontal row being the same for corresponding meaningful and meaningless designs. In other words, the only difference was in the vertical displacement of the entire horizontal rows of stimulus squares other than the first or top row. Since the subjects always worked from left to right within a given design, the series of responses required within a given row of any meaningless design was exactly the same as that required within one of the rows of the corresponding meaningful figures, and the first rows of corresponding meaningful and meaningless figures were identical in every case. The corresponding meaningful and meaningless figures occupied the same position on their respective sheets, *e.g.*, the third meaningful figure had as its control the third design on the corresponding sheet of meaningless designs. The meaningless designs in Form C were constructed from the respective designs in Form B, whereas those in Form D were constructed from the meaningful figures in Form A.

Each stimulus design, with its corresponding reaction spaces, was enclosed in its own rectangular box, 2 inches wide and $3\frac{1}{4}$ inches high, so as to avoid confusion between adjacent designs. The designs were numbered consecutively from 1 to 12. Each sheet of material was printed* on standard bond paper, $8\frac{1}{2} \times 11$ inches. The originals were made up in enlarged form with careful precision, so that when reduced for printing any possible inaccuracies were virtually eliminated.

* The material was reproduced by lithoprinting by the National Process Company, New York City.

In addition to the four separate sheets of stimulus designs, the experimenter utilized a large demonstration chart, composed of an identical key of 6 squares and associated numbers, and a meaningless stimulus design of 3 rows of 3 squares each, together with a corresponding set of reaction spaces below. The correct numerical entries had been made in the first four of these spaces. The entire chart was approximately 24 inches wide and 40 inches high, so that it could be easily seen by an entire group of experimental subjects.

3. PROCEDURE

Preliminary experimentation was carried out on a group of 8 graduate students at Columbia University in order to determine the relative meaningful characteristics of a large number of possible stimulus designs, and, when suitable figures had been selected, in order to determine the total amount of time necessary to complete each entire sheet, using the "work limit" method. Following minor subsequent adjustments, all four forms were serially presented to a second preliminary group of 30 Barnard College psychology students, representative samples of the population to which the experiment was to be ultimately administered. A "time limit" method was employed, the subjects being allowed 5 minutes of working time, this interval having been chosen on the basis of the results obtained above. Information derived from a study of these data, both objective and introspective, led to a further and final readjustment and reduction of the time limit.

The procedure employed in the experiment proper was as follows. All members of the experimental group having been equipped with No. 2 lead pencils, the demonstration chart was exposed. The chart and its use were briefly and concisely described. Attention was first called to the key, composed of six different squares, each paired with a number from 1 to 6. Then the figure or stimulus design was indicated, composed of various combinations of small squares like the ones in the key above. Below this, the corresponding set of reaction spaces was pointed out, and the first four numerical substitutions, already filled in on the chart, were briefly described with reference to their corresponding position and appearance in the design itself as well as in the above key. The subjects then responded orally, in unison, by naming in order the correct numerical substitutions in the remaining reaction spaces. The demonstration chart was then reversed, so as to prevent further memorization of the key. If there were no further questions con-

cerning the procedure, the first experimental sheet of designs was distributed, face down.

The subjects were instructed to keep the sheets face down on their desks until given further specific directions. The names of the subjects and the series identification letters were written on the back of the sheet, after which final and more specific instructions were administered. The subjects were told that at the signal "begin!" they were to start with the first design in the upper left-hand corner and fill in all the correct numbers as they had done orally in the demonstration chart. It was emphasized that they were always to work across a row of spaces from left to right within each design, and to finish each row before beginning the next one below. Likewise, they were to finish each design before going on to the next, and were to take them in order without omitting any. They were told furthermore that the first row of designs consisted of 16 squares, whereas succeeding rows contained 25 squares, 5 rows of 5 squares each, but that all were to be done in exactly the same way. Emphasis was also placed upon the fact that no marks whatsoever were to be made upon the designs themselves.

The subjects were then informed that their sheet contained only meaningful or meaningless designs, depending upon which form they had on that particular trial. If Forms C or D were being administered, they were reminded that every one of such designs was a purely *meaningless* or *nonsense* figure. If, however, Forms A or B were being used, they were told that every design on the sheet was *meaningful*—an *actual picture* of a *real object*, such as a letter, landscape, common household object, or the face, head, or body of a man or animal. The experimenter placed great emphasis upon this fact, so that the "mental set" of the subjects would be invariably such as to enhance the nature of the particular type of material being employed at the moment. Finally, the subjects were instructed to work as rapidly and accurately as they could until told to stop. A preliminary "ready!" signal was then given, followed by the signal "begin!". When 4 minutes (timed by a stop-watch) had elapsed, the signal "stop!" was given. The papers were immediately turned over and collected, and the second of the four forms was passed out. It might be noted that this time interval was selected as one which was as long as possible without permitting any subject to complete the entire sheet of designs. Although inspection of the individual scores might lead one to think that more time might profitably have been allowed, the fact that one

subject finished two of the four forms* indicates that the interval chosen was as long as could have been employed.

Similar instructions were administered for all four forms, the meaningful or meaningless characteristic of the particular sheet being repeatedly emphasized each time, and the subjects being requested to work as rapidly and accurately as possible. A work period of 4 minutes was allowed on each of the four forms. Following the fourth, or last, sheet, introspections were obtained. The subjects were requested to answer the following questions as accurately and definitely as possible: (1) Which seemed to offer the greater difficulty, the meaningful or meaningless forms? (2) What was the nature of the difficulty? (3) How was the difficulty overcome? If the subjects were unable to answer any question, they were to leave it blank. Opportunity was also given to add any additional introspections or remarks. The experiment was conducted in all of the groups by the writer. The time required for the entire experiment was approximately 40 minutes.

The four forms were presented in the serial order CABD to a total group of 67 experimental subjects, and in the order BDCA to a different total group of 59 subjects. For a comparison of these groups in age and "intelligence," the reader is referred to the section on *Results* below. It will be noted that intra-group controls have in both cases been utilized with reference to the vitiating effect of practice, *i.e.*, one type of designs is placed at each extreme (beginning and end) of the series, while the other type of material occupies the two intermediary positions. Summation of scores from similar material within each presentation order thus greatly diminishes the differential practice effect, since the latter continues throughout the series of four experimental sheets. The differential effect is not entirely eliminated by this means alone, however, since the effect does not progress linearly throughout the series. From common knowledge of the characteristics of learning curves, it at once becomes apparent that if only intra-group control of this nature were utilized, an undue advantage would be given to the form placed second in the series of four sheets, since it would benefit disproportionately more from practice than would succeeding forms. Thus the additional sequence BDCA was employed which, although continuing to utilize intra-group control, gave practice advantage to the other kind of

* Given an extrapolated score.

material, thereby virtually eliminating any differential effects of practice upon the two types of material when final summative or average scores from both presentation orders were computed. This is essentially a modified rotation method. Attention is also called to the fact that the sequences CABD and BDCA were purposely employed so that meaningless Form D, for example, which was derived from Form A, was separated from A by another form. Inspection of the materials will show that this rule was applied throughout, so that the chances for identifying or perceiving meaning in a meaningless design as a result of having seen its corresponding meaningful design in a previous form were greatly diminished.

The four experimental sheets, or forms, were scored independently, the scores for each sheet including number of correct numerical substitutions, number of incorrect substitutions, and total number of substitutions.

4. RESULTS

The composition of the various groups used in the present experiment is reported in Table I. Although the ranges in age within each of the two groups receiving the different presentation orders was practically the same, Group I (BDCA order) was slightly younger and somewhat more homogeneous with respect to age. This age difference, however, is unreliable, as will be seen from Table II, since the resulting $D/\sigma_{diff.}$ is less than 3.0. With

TABLE I*
COMPOSITION OF GROUPS

Group	N	Presenta- tion Order	Age in Months			Scholastic Aptitude Test Score		
			Mean	S.D.	Range	Mean	S.D.	Range
I	59	BDCA	224.1	10.7	191-271	1017.1	135.6	759-1490
II	67	CABD	230.7	16.6	196-263	997.0	129.2	726-1244
Total Group	126		227.6	17.2	191-271	1006.2	133.1	726-1490

* For a justification of the number of significant figures used throughout the present study, the reader is referred to Pearson, Karl, *Mathematical Contributions to the Theory of Evolution: IV. On the General Theory of Skew Correlation and Non-Linear Regression. Draper's Co. Res. Mem., Biometric Series, II, 1905, 53-54.* It will of course be remembered that accuracy of computation is quite independent of accuracy of measurement.

respect to "intelligence" even less difference is found between the two groups receiving the experimental material in different presentation orders. The difference of 20.1 in Scholastic Aptitude Test score is very unreliable, as indicated by a $D/\sigma_{diff.}$ of 0.8471. Since no reliable differences exist between the two subgroups in age and "intelligence," they can be treated as equivalent groups, and can therefore be used as mutual controls in the elimination of practice effect. The data on age and "intelligence" for the

TABLE II
RELIABILITY OF INTER-GROUP DIFFERENCES IN AGE AND INTELLIGENCE

<i>Variable</i>	<i>Difference</i>	$\sigma_{diff.}$	$D/\sigma_{diff.}$
Age in Months	6.6	2.4617	2.6811
Scholastic Aptitude Test Score.....	20.1	23.7280	0.8471

total group of 126 subjects were computed directly from the entire distribution, rather than by averaging the results for the separate subgroups, and thus furnish a true characterization of the group as a whole. The above data may be more generally evaluated by comparison with the norms for similar groups previously reported in the section on Subjects.

The mean scores on each of the four experimental forms for the two presentation orders, as well as for these orders combined, are reported in Table III. It should be kept in mind that throughout Experiments I and II, whenever scores of groups receiving different presentation orders were combined, so as to obtain a value free from practice effects, the mean scores for the individual groups were averaged. Thus the group with the largest N

TABLE III
MEAN SCORES ON SEPARATE FORMS

<i>Presentation Order</i>	<i>Mean Scores</i>			
	<i>Form A</i>	<i>Form B</i>	<i>Form C</i>	<i>Form D</i>
BDCA	126.2712	63.5424	132.0847	109.4407
CABD	80.0149	104.4776	81.9851	132.9851
Combined*	103.1431	84.0100	107.0349	121.2129

* All of these values were obtained by averaging the corresponding values for groups I and II.

did not have more weight in determining the final result. By "score" is meant the total number of correct differentiations or substitutions made in each form. The incorrect substitutions are designated as "errors," and will be discussed independently below.

A comparison of scores made on the meaningful and meaningless material will be found in Table IV. It is immediately evident that in both presentation orders, the meaningless material yielded higher scores, indicating that the so-called meaningful context offered greater difficulty to the process of perceptual differentiation. This finding is all the more significant in view of the fact that in one of the presentation orders, CABD, the factor or factors under investigation worked counter to and overcame a slight though noticeable practice effect. The final combined values, obtained by averaging the corresponding values for the two separate presentation groups, showed that on the average over 20 more perceptual differentiations, and consequent numerical substitutions, were made in designs of so-called meaningless context than in the corresponding designs of meaningful context. The S.D.'s

TABLE IV
COMPARISON OF MEANINGFUL AND MEANINGLESS FORMS

<i>Presentation Order</i>	<i>Meaningful:</i>	<i>Meaningless:</i>	<i>Difference:</i>	<i>Variability:</i>
	$\frac{A+B}{2}$	$\frac{C+D}{2}$	$\frac{C+D}{2} - \frac{A+B}{2}$	$\left(\frac{C+D}{2} - \frac{A+B}{2} \right)$ S.D. of
BDCA	94.9068	120.7627	+ 25.8559	11.3798
CABD	92.2463	107.4851	+ 15.2388	9.3542
Combined* ...	93.5766	114.1239	+ 20.5474	10.3670

* All of these values were obtained by *averaging* the corresponding values for groups I and II.

of these differences, also reported in Table IV, show the amount of variation in this phenomenon, the degree to which individuals differ in their susceptibility to the differential influence of the two types of context.

In order to evaluate the mean difference of 20.5474 found between meaningful and meaningless forms, it was necessary to compute the Standard Error of this difference. Since the same individuals took all forms, the S.E.'s were computed directly from the differences themselves rather than from the separate

scores on each form. The use of equivalent groups, each of which was differentially affected by practice, presented a special difficulty in arriving at such a measure. The method finally adopted was to determine the limits within which the actual or "corrected" S.E. should fall. The S.E. computed by lumping both groups into one distribution yields a value which is too large, since the S.D. in this group will be spuriously large as a result of the differential practice effect. On the other hand, if a separate S.D. is computed for each group and these S.D.'s averaged to obtain an estimate of the S.D. of the total group free from practice effects, this value, together with the corresponding S.E. computed from it, will be too small, for at least two reasons. Firstly, the S.D. of a large group, other things being equal, will usually be larger than that of a smaller group; and secondly, the mere presence of the practice effect does actually reduce the reliability of the results by introducing an additional cause for individual variation, and hence should not be totally eliminated. Accordingly,

TABLE V

EVALUATION OF DIFFERENCE BETWEEN MEANINGFUL AND MEANINGLESS FORMS

<i>Method of Computation</i>	<i>S.D</i>	<i>$\sigma_{diff.}$</i>	<i>$D/\sigma_{diff.}$ ($D = 20.5474$)</i>
Combined	10.3670	0.9236	22.2471
Total	11.6297	1.0361	19.8315

the S.E. was computed by both methods, and the values so obtained are reported in Table V. For purposes of convenience, the term "combined" will henceforth be used to refer to values obtained by the latter method of computation, and the term "total" will be applied to values obtained by the former method. It will be noted that the difference between meaningful and meaningless forms is highly reliable when tested by either method, and the critical ratio can be safely assumed to lie between 19.8315 and 22.2471. Additional evidence of the reliability of this difference is to be found in the reliabilities of the corresponding difference within each presentation group. By reference to Table IV it will be seen that these differences are 25.8859 for the presentation order BDCA, and 15.2388 for the order CABD. The S.E.'s of these differences (not given in the Table) are 1.4815 and 1.1428, respectively, showing that both differences are highly reliable. The

general significance of these differences is even further brought out by the fact that in the presentation order BDCA, none of the individual subjects showed an equal or a larger score on the combined meaningful forms than on the combined meaningless forms, and only four subjects showed such a relationship in the presentation order CABD. It will be recalled that in the latter order practice effect operated counter to the differential influence of context.

The preceding discussion has dealt with correct substitutions. An analysis of the mean number of errors made on each of the four forms, together with the errors made on combined meaningful and meaningless material, is presented in Table VI. Inspection

TABLE VI
ANALYSIS OF ERRORS

<i>Presentation Order</i>	<i>Mean Number of Errors</i>					
	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	$\frac{A+B}{2}$	$\frac{C+D}{2}$
BDCA	1.4407	1.1017	1.3729	0.7797	1.2712	1.0763
CABD	0.6119	0.9104	0.9104	0.7313	0.7612	0.8209
Combined ...	1.0263	1.0061	1.1417	0.7555	1.0162	0.9486

of these data will show no marked trend in the distribution of these errors with respect to the different types of material. The number of errors on the combined meaningless forms is slightly less than that on the combined meaningful forms, which supports the findings on correct substitutions. The extremely small size of the difference, however, together with the fact that errors were very infrequent, makes further analysis of errors unwarranted. It thus seems that the task of differentiating the various designs, although requiring differing amounts of time for different types of material, was not of a sufficient difficulty to result in an undue amount of error on the part of the adult subjects. The differentiation could be made correctly, although the process was slower in the case of the so-called meaningful contexts. In further support of this contention, it is interesting to note that there is no consistent change in the mean number of errors with practice.

In order to investigate the question of the relationship between "intelligence" test score and the effect of context on perceptual dif-

ferentiation, Tables VII and VIII were prepared. Owing to the presence of a practice effect on successive forms, it was impossible to utilize the correlation technique to investigate this relationship. If correlations were computed within each presentation order, the difference between meaningful and meaningless forms for each individual could not be taken as a measure of the influence of context, since the practice effect had entered in either to increase or decrease this difference. On the other hand, if both presentation orders were combined in the computation of a single correlation, there would be, in addition to the above error, a spurious reduction in the size of the correlation coefficient, due to the differential effects of practice upon the subjects in the two groups. The following technique was therefore utilized. The 10 individual subjects making the highest and the 10 making the lowest Scholastic Aptitude Test scores within each presentation order were first selected, thus yielding two groups of 20 subjects each in which the differential influence of practice was eliminated. The mean scores and number of errors made by each of these groups on each of the four forms were computed, and these data are presented in Table VII.

TABLE VII

COMPARISON OF SEPARATE FORMS IN GROUPS OF DIFFERING INTELLECTUAL LEVEL

<i>Group</i> <i>Form</i>	<i>20 Highest</i>				<i>20 Lowest</i>			
	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>
Mean Score	116.75	92.05	120.80	132.10	88.15	72.70	91.95	110.80
Mean Number of Errors	0.65	0.70	0.95	0.55	0.95	0.90	2.35	0.60
Mean Score on Scholastic Aptitude Test	1198.6				821.3			

The two groups show a wide and undoubtedly reliable difference in "intelligence" test score, the mean of the 20 highest being 1198.6, and that of the 20 lowest, 821.3. The distinctiveness of these groups is further shown by the fact that there was no overlapping in "intelligence" scores between the two groups, the range in the highest group being from 1112 to 1490, and in the lowest group from 726 to 882. It will be readily seen that the group making higher "intelligence" test scores also makes distinctly higher scores in perceptual differentiation on each of the four experimental forms. They also tend to make fewer errors, although this tendency is by no means marked.

TABLE VIII

COMPARISON OF MEANINGFUL AND MEANINGLESS FORMS IN GROUPS OF DIFFERING INTELLECTUAL LEVEL

Group	Mean Scores			Mean Number of Errors		
	$\frac{A+B}{2}$	$\frac{C+D}{2}$	$\frac{C+D}{2} - \frac{A+B}{2}$	$\frac{A+B}{2}$	$\frac{C+D}{2}$	$\frac{C+D}{2} - \frac{A+B}{2}$
20 Highest	104.40	126.45	+ 22.05	0.68	0.75	+ 0.07
20 Lowest	80.43	101.38	+ 20.95	0.93	1.48	+ 0.55

In Table VIII the scores and errors made by the two groups of widely differing intellectual level are combined with respect to the effect of meaningful and meaningless material. Both groups are affected similarly by context, in that both make decidedly larger scores on the meaningless forms. The difference is not only in the same direction, but is also strikingly similar in amount, being 22.05 for the 20 highest, and 20.95 for the 20 lowest. Thus there is no relationship between the intellectual level of the subjects and the degree to which they are differentially affected by context. The number of errors is too small to warrant much consideration, although it is interesting to note that the differences are again in the same direction in both groups.

As stated in the preceding section, an attempt was made to obtain introspections in as nearly objective and comparable form as possible by means of carefully selected questions. The introspections thus reported are necessarily open to all of the difficulties inherent in the introspective technique, as well as to the additional error of the differential effect of practice on meaningful and meaningless material within any given presentation order. This error was largely, though not entirely, overcome in Experiment I through the additional use of intra-group control, and thus the introspections in this experiment are not without some value. They therefore deserve more consideration than do those obtained in Experiment II, where only inter-group control was utilized.

In answer to question 1 regarding which type of material, meaningful or meaningless, seemed to offer greater difficulty, it was found that in general the introspective reports agreed with the objective findings. More specifically, in the presentation order CABD, only 4 of the 67 subjects reported that the meaningless material was more difficult. Only 2 of these 4 actually showed this relationship in their objective scores, the other 2 showing just the opposite result

to that introspectively reported. A total of 23 subjects reported no difference in difficulty between the two types of material. Not one of these objectively showed such an equality and only one actually made a higher score on the meaningful forms. The remaining 40 subjects in this presentation order reported that the so-called meaningful material was more difficult, and only one of these showed a higher score on the meaningless forms. In the presentation order BDCA, 4 of the 59 subjects reported the meaningless forms to be more difficult and 12 reported no difference in difficulty, although the objective data of all of these subjects showed just the opposite result. The remaining 43 subjects in this subgroup reported that the meaningful forms were more difficult, and this agreed with the objective data of all of these subjects.

The responses to question 2, concerning the nature of the difficulty, are less easily summarized. Approximately half of the subjects left the question unanswered, indicating lack of knowledge concerning such factor or factors. From those answering, two general classes of response were obtained. Some reported that the representative or pictorial character of the meaningful material made such forms more difficult to differentiate perceptually. The following are representative of such reports:

- "because the meaning of the whole design made one lose track of the individual squares."
- "because of the distracting nature of the meaningful figures."
- "because it was easier to see the animal or scene portrayed rather than the separate squares."
- "distracted by subject matter."
- "because the meaningful interpretation and object would interfere—as for instance the picture of the dog, which brought up thoughts and ideas about dogs, and therefore drew attention away from the squares."
- "picture harder than geometric design because of meaningful associations."

About an equal number of the subjects reported that the major factor involved seemed to be a difference in the physical aspects of the stimuli, the meaningful forms showing a more compact and undistributed arrangement of homogeneous "color" than the corresponding meaningless forms. This characteristic has been subsequently termed "compactness," and will be discussed in greater detail at the end of the present section. Typical examples of these introspections are as follows:

- “because of arrangement—easier to analyze construction in the meaningless designs.”
- “diversity in coloring; seemed to be less cut up than meaningless forms.”
- “because of arrangement of particular squares side by side, making it harder to visualize the squares as such in meaningful pictures.”
- “harder to discern the nature of the squares in meaningful—they didn’t seem as well defined as the meaningless material.”
- “spaces more indistinguishable as separate blocks.”
- “the squares of the meaningful designs seemed to run into one another, while those of the meaningless stood out very clearly.”

Only 38% of the subjects answered question 3 concerning attempts to overcome the difficulty. Of these, approximately one-half stated that no special technique had been employed. The others reported a wide variety of attempted devices, such as concentrating harder on the task, trying to disregard the meaning, focusing attention on the parts rather than on the whole, visualizing lines drawn upon the design, etc. Some subjects listed more than one of these techniques. The device reported seemed to bear no relationship to the answers to questions 1 and 2 reported above.

The introspections, especially the answers to question 2, confirmed the previously stated need of a further experiment in order to interpret the results with any degree of validity. Detailed examination of the experimental forms will show that although the same total and serial responses are made within the individual rows of corresponding meaningful and meaningless designs, there nevertheless is a differential factor of “compactness” of black-white pattern which has been introduced by the mere vertical displacement of horizontal rows in the construction of the control or meaningless designs. As previously stated, the term “compactness” is here used to denote the degree to which adjacent masses of black or white occurred in the total design. Thus a relatively “compact” design would be one in which the black areas clustered together in a more or less solid mass with minimal contour. A relatively less “compact” design, on the other hand, would be one in which the black areas were more or less scattered throughout the pattern and interspersed with white areas, thereby increasing the contour.

In order to arrive at an objective index of “compactness,” the following method was employed. The contour of each design in the four experimental forms was obtained by adding together the exter-

nal and internal (when present) perimeters of the black part of the pattern. In Table IX will be found the mean contour in inches of

TABLE IX
RELATIVE "COMPACTNESS" OF MEANINGFUL AND MEANINGLESS DESIGNS

<i>Form</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>
Mean Contour in Inches	5.89	5.74	7.03	7.52
<i>Forms Compared</i>	<i>D - A</i>		<i>C - B</i>	
Mean Difference	1.63		1.29	
$\sigma_{diff.}$	0.2977		0.1821	
$D/\sigma_{diff.}$	5.4753		7.0840	

the designs in each of the four forms, as well as an evaluation of the differences between the corresponding meaningful and meaningless forms. It will be seen that the designs in the so-called meaningful forms are reliably more "compact" than the corresponding meaningless designs. It should be added that in no case was the contour of a meaningful design larger than that of its control meaningless design, and only one design in each of the two forms had the same size of contour in both cases. Thus, since the designs differed both in (1) "meaningfulness," or conventionalized representation, and (2) "compactness," a second investigation was necessary in order to determine the relative importance of these factors in producing the differences obtained.

CHAPTER III

EXPERIMENT II

The data of this experiment were collected during the academic year 1934-35.

1. SUBJECTS

Both adults and children were employed in the present experiment. The adult subjects* were 141 female students, all of whom were enrolled in psychology courses at Barnard College, Columbia University. This group was in every way similar to that used in Experiment I. The ages ranged from 16 years-4 months to 29 years-3 months, with an S.D. of 22.1 months, and a mean age of 19 years-4 months. The range in "intelligence" test scores, as determined by the Scholastic Aptitude Test of the College Entrance Examination Board (34), was from 714 to 1445, with an S.D. of 137.0, and a mean score of 1030.5.

The children employed as subjects* numbered 121, 63 males and 58 females, all of whom were sixth grade pupils at Public School 167 in Brooklyn, N. Y. The group was relatively heterogeneous with respect to socio-economic background, age, and "intelligence." The mean age of the children employed was 10 years-10 months, with an S.D. of 9.2 months, and a range from 9 years-9 months to 15 years-4 months. "Intelligence" test scores were obtained for all children subjects on the National Intelligence Test, and these point scores were transmuted into Mental Ages, from which I.Q.'s were computed. Since the original point scores were not available in all cases, it was necessary to employ I.Q.'s for the entire group. The error thus introduced was relatively insignificant for the purposes of the present experiment, since only extreme deviations in intelligence were utilized. The mean I.Q. for the group was 116.6, the S.D. being 17.4, and the range being from 73 to 156.

Thus, whereas the adult subjects employed in the present study would be expected to manifest relatively complex perceptual behavior, the children, because of their earlier psychobiological status, would be expected to show different, if not less complex, perceptual reactions; and a comparison of the perceptual behavior of the two groups might not be without value. Further discussion of the subjects as actually employed in Experiment II will be given below.

* Exclusive of preliminary subjects.

An additional group of 35 male college students was employed in a final specific check upon the influence of "compactness." These subjects will be described more fully in connection with the report of this part of the experiment.

2. MATERIALS

The materials used in Experiment II consisted essentially in modifications of those employed in Experiment I, with certain additions and rearrangements. In general, an attempt was made to construct these materials in such a way that the factors of meaning, or conventionalized representation, and "compactness" could be isolated and independently investigated. Three forms were employed. The designs in Form A may be characterized as both meaningful and "compact." Those in Form B were equally "compact," but relatively meaningless. In Form C, they were relatively meaningless and less "compact" than in the other two forms. These three sheets of experimental material have been reproduced in reduced form in Figures III, IV, and V.

Each of such forms contained a key composed of six different squares, each paired with a number from 1 to 6. Directly below the key were 16 different stimulus designs, 4 rows of 4 designs each, each of such figures being exclusively constructed from the 6 squares in the key. The four designs in the first row of each sheet were made up of 16 squares, 4 rows of 4 squares each, whereas those in the remaining rows contained 25 squares, 5 rows of 5 squares each. Below each stimulus design, and situated more or less randomly to the left or right within each row, was a composite set of reaction spaces, as in the materials of Experiment I. The same precautions were observed to preclude the use of artificial aids to perceptual differentiation on the part of the subjects. The relative proportions and general topography of the layout of this material were exactly the same as in Experiment I, with the following exceptions. (a) The absolute size of all printed matter on all sheets was slightly, though almost imperceptibly, reduced from the absolute size of the materials employed in Experiment I. (b) All stimulus designs and corresponding reaction spaces contained a black border approximately 1/20-inch wide, so as possibly to increase the difficulty of perceptual differentiation, as well as to reduce the possibility of the subjects' perception of meaning in the meaningless designs, especially those of Form B. (c) A larger sheet of paper was utilized so as to accommodate the increased number of designs.

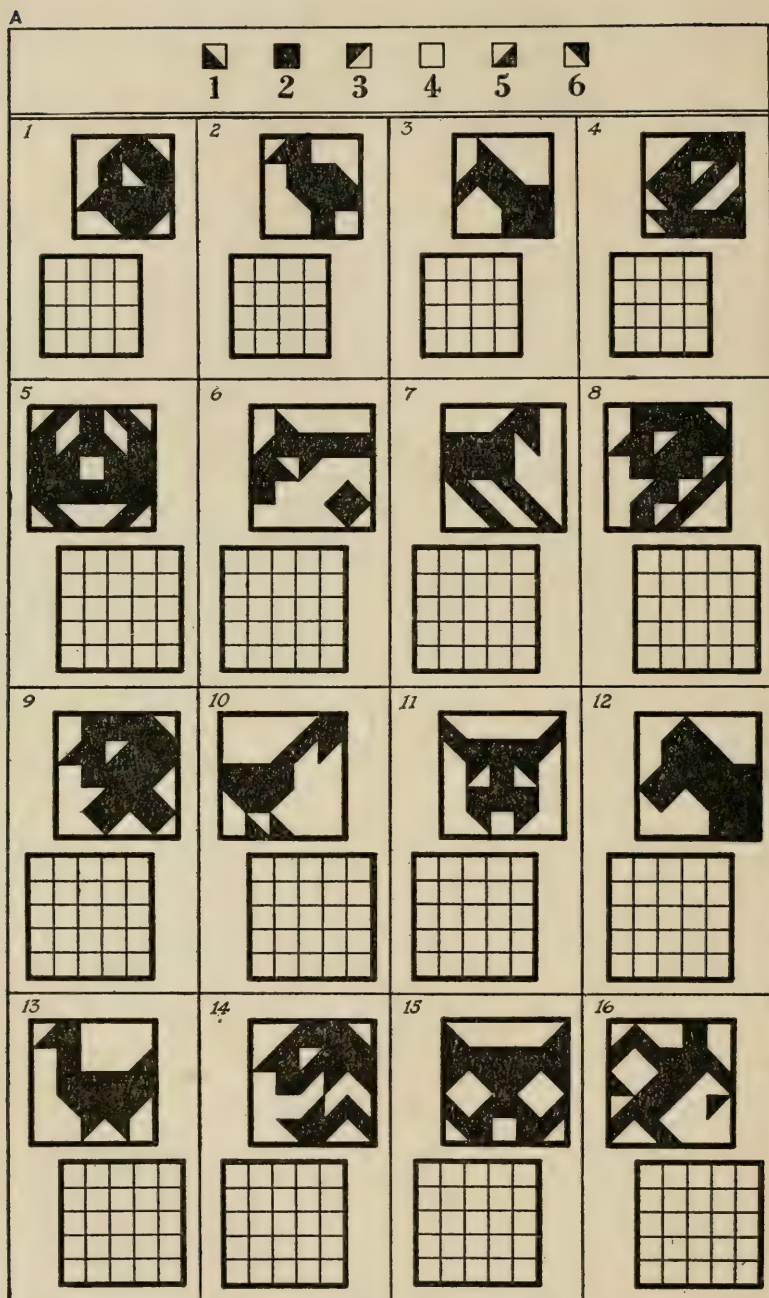


FIGURE III
Form A employed in Experiment II
(Reduced to 56% of original size)

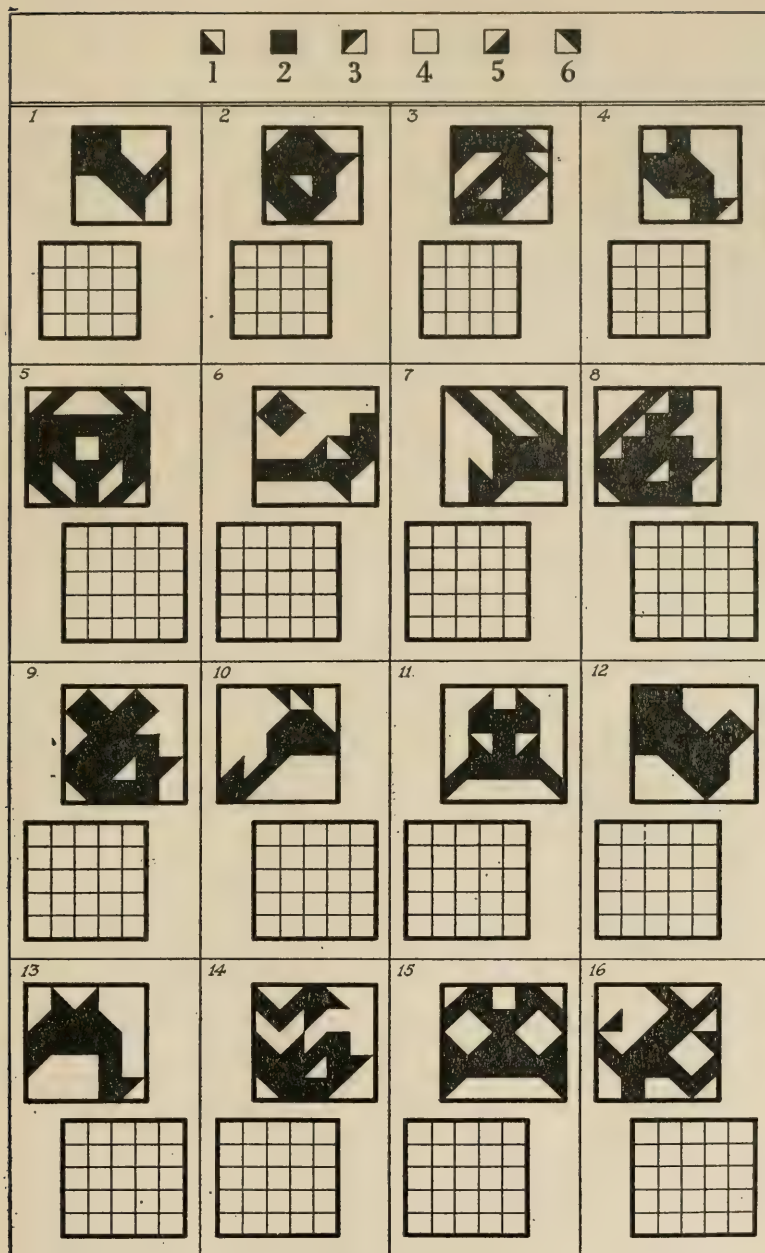


FIGURE IV
Form B employed in Experiment II
(Reduced to 56% of original size)

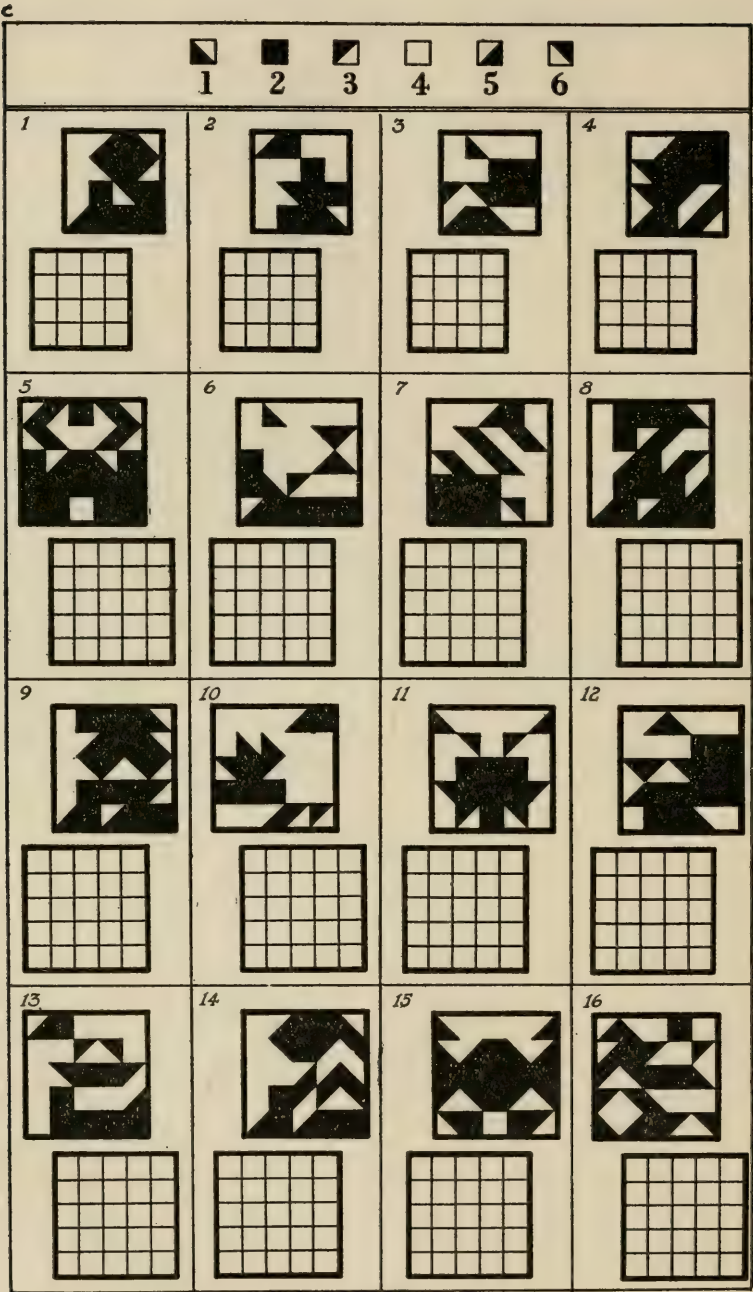


FIGURE V
Form C employed in Experiment II
(Reduced to 56% of original size)

Form A was exclusively composed of meaningful designs, selected from those in Experiment I on the basis of (a) their meaningful appearance or associations, and (b) their lack of symmetry. Form B contained relatively meaningless designs, formed by completely inverting each respective design in Form A, all figures except those in the first row retaining their same relative position on the sheet. The first four figures were serially rearranged, so as to reduce the recognition value of their having been seen as meaningful designs by those subjects who had previously taken Form A. Only the first four figures were rearranged, since it was correctly assumed that all subjects would progress beyond the first row of material, thereby stopping on designs which were strictly comparable with corresponding spatially located figures in the other forms. The procedure of utilizing inverted designs in Form B accounts for the criterion of asymmetry employed in the *a priori* selection of designs for Form A, since the more symmetrical figures would have tended to retain meaningful characteristics when inverted, thereby detracting from their usefulness in the present study. It will be parenthetically noted, however, that inversion of the designs introduces discrepancies in the particular numerical responses made to a given stimulus square, *i.e.*, squares 2 and 4, black and white respectively, remain the same, but squares 1 and 6 and squares 3 and 5 interchange associated numbers, since the key objectively remains the same—uninverted. Form C was composed of meaningless designs, constructed from the figures of Form A according to the procedure and rules set forth in the discussion of materials for Experiment I. In all three forms, the corresponding meaningful and meaningless figures occupied the same relative or serial positions on their respective sheets, with the single exception in Form B mentioned above.

As in Experiment I, each stimulus design, with its corresponding reaction spaces, was enclosed in its own rectangular box, and the designs were numbered consecutively from 1 to 16. All forms were lithoprinted on standard legal size bond paper, $8\frac{1}{2} \times 12$ inches. As before, all possible errors in drawing were completely eliminated following reduction of the original drawings for printing.

In addition to the three separate sheets of stimulus designs, the experimenter utilized the large group demonstration chart described in Chapter II, as well as individual samples cut from the meaningless Forms C and D of Experiment I. These sheets contained only the key and first stimulus design and corresponding reaction spaces, and were used further to demonstrate and clarify

the procedure for the experimental subjects, particularly the children.

3. PROCEDURE

On the basis of the data derived in Experiment I, tentative directions for the administration of the modified experimental sheets of Experiment II were devised. The three forms were then serially presented to an additional preliminary group of 8 Barnard College psychology students, representative of the adult population to be used in the experiment proper. A time limit of 5 minutes was allowed on each form, this being calculated as roughly proportional to the 4 minute interval used for the 12 figures of each sheet in Experiment I. Although inspection of the individual scores suggested the possibility of lengthening this time limit, it was decided to retain the 5 minute interval so as to preclude the remotest possibility of any subject's finishing a given form within the allotted time. A longer time limit would also have led to an undue amount of strain and exhaustion, since the task required, and received, a high degree of sustained attention from the adult subjects throughout the work period.

The procedure actually employed in the experiment proper with the adult subjects was very similar to that used in Experiment I. After presentation of the demonstration chart, with attendant explanation by the experimenter and oral responses on the part of the subjects, the chart was reversed and the individual sample sheets were distributed, face down. At a prearranged signal from the experimenter, the subjects recited the correct numerical substitutions in unison, at the same time filling in the correct numbers in their appropriate reaction spaces. The tempo was rapid in order to prevent additional memorization of the key. The sheets were then immediately turned over and collected, and any additional questions concerning the procedure were answered.

The subjects were then told that they were going to be given three different sheets of designs, one of which would be meaningful and the other two meaningless. The contrasting nature of the meaningful and meaningless material was emphasized, as in Experiment I. The statement was also made that the subjects were to be told before they began each time which sheet they had been given.* The

* As will later become apparent, it was necessary to inform all subjects beforehand that they would receive both meaningful and meaningless designs, because of the grouping of the children into classes of widely differing ability. This necessitated the simultaneous administration of all three forms to different children at each trial in order that data from the different (rotated) serial presentations would be comparable.

first experimental sheet was then passed out, face down, with the instructions to await further specific directions. The names of the subjects and the series identification letters were written on the back of the sheet. The general characteristics of the form were then described, and the rules regarding working from left to right without omission, etc., were clearly stated, as in Experiment I. No marks whatsoever were to be made on the designs themselves, and the subjects were asked always to keep the sheet directly in front of them at right angles to the body, the edges of the sheet being parallel to the sides of the desk. This was done so as to reduce the possibility of the perception of meaning in the inverted designs of Form B.

The subjects were then told which type of design their sheet contained on that particular trial, and the meaningful or meaningless nature of such figures was made as graphic as possible. Finally, the subjects were instructed to work as rapidly and accurately as they could until told to stop. The signals "ready!", "begin!" were then given, and 5 minutes were allowed for work, at which time the signal "stop!" was given. Papers were immediately turned over and collected, and the second of the three forms was distributed. Similar instructions were administered for all sheets. A work period of 5 minutes was allowed on each of the three forms, and introspections were obtained following the last sheet, as in Experiment I above. The questions were modified slightly from those employed in the previous experiment, and included the following: (1) Which seemed to offer the greater difficulty, the meaningful (A) or meaningless forms (B and C taken together)? Also, which of the two meaningless forms, B or C, offered the greater difficulty? (2) What was the nature of the difficulty? (3) How was the difficulty overcome? After opportunity had been given to add any additional introspections or remarks, the subjects were asked to indicate if any meaning had been perceived in either of the meaningless forms. Introspections were taken even though they would perhaps be invalidated by the subjects' inability subjectively to eliminate the vitiating effect of practice. The subjects' attention was called to this fact, and they were asked to take it into consideration.

A modified method of rotation was employed to control practice effect, the 3 forms being presented in the serial orders ACB, BAC, and CBA to groups of 46, 48, and 47 subjects, respectively. For a comparison of these subgroups in age and "intelligence,"

the reader is referred to the section on *Results* below. Attention is called to the fact that the three particular sequences used resulted in Form B following Form A in only one of the three cases (ACB), and even here form C intervened. It will be recalled that the meaningless Form B contained the inverted meaningful designs from Form A, and since it was highly desirable that the subjects fail to recognize this fact, the use of presentation orders in which Form B followed A was minimized. Thus fewer subjects had the opportunity to be influenced by having seen the corresponding meaningful designs in a previous form (A). Had the forms been presented in the order ABC, for example, the orders BCA and CAB would have been necessitated, in which case Form B would have followed A in two cases rather than only one, as in the present study. As in Experiment I, the study was conducted in all groups by the writer.

The procedure employed with the group of children was the same as that used with the adult subjects, with the following exceptions: (1) Descriptions of materials and methods* were couched in simple terminology appropriate to the mental status of the subjects. (2) More time was given to such description,* and if a given child failed to understand directions he was given personal instruction, the remainder of the subjects leaving their sample sheets face down so as to avoid undue memorization of the key. (3) All three presentation orders, ACB, BAC, and CBA, were given simultaneously to different sections of the class. This was essential because of the system of ability grouping employed in the school system. The matter was accomplished by dividing each class, which always consisted of six rows of pupils, into three groups of two rows each. These three groups were approximately identical in size within each class, and contained the same relative proportions of males and females. The more or less intrinsic unity of each of such groups was emphasized, and it was clearly explained that each would work with a different kind of design on a given trial, but that before the experiment was over all would have had the same designs, so as to "play fair" in all groups. The designs were then presented in much the same fashion as with the adult subjects, the forms being administered in the orders ACB, BAC, and CBA to each of the three groups, respec-

*Difficulty was experienced in endeavoring to have the children keep their papers at right angles to the body, with the edges of the sheet parallel to the sides of the desk. This undoubtedly resulted from the Palmer method of writing, with which they are thoroughly imbued.

tively. Practice effect was thus controlled by rotation, as above. The meaningful or meaningless nature of the designs was vividly pictured to each separate group immediately prior to work on that trial, and all groups were asked each time to work as quickly and with as few mistakes as possible. (4) A work period of 12 minutes, determined by preliminary experimentation, was employed. It was found profitable to use such a relatively long interval since the children worked much more slowly than did the adult subjects, and, in addition, did not concentrate so intensively, and hence were less susceptible to strain and fatigue. At the end of 10 minutes of work on each form, the children were told that they had but a little time left. This served as an incentive to greater effort, and tended to counteract the negative influences of distraction, monotony, and fatigue.

Although undoubtedly of questionable value, complete introspections similar to those of the adult experiment were obtained, the questions being worded in a more elementary fashion, *e.g.*, which was "harder," etc. Additional comments were also requested, after which the children were asked to indicate if any meaning had been perceived in either of the meaningless forms. All experiments on children were also administered by the writer, with the additional help of a trained assistant.

4. RESULTS

In Table X is reported the composition of the subgroups of adult subjects used with each of the three presentation orders in Experiment II. The same data regarding the chronological and intellectual status of the subgroups of children used as subjects are reported in Table XI. It will be seen that for both adults and children, the inter-group differences are very slight.

TABLE X
COMPOSITION OF GROUPS: ADULTS

Group	N	Presenta- tion Order	Age in Months			Scholastic Aptitude Test Score		
			Mean	S.D.	Range	Mean	S.D.	Range
I	46	ACB	238.8	24.1	207-351	1023.0	142.5	734-1445
II	48	BAC	231.7	23.0	196-296	1023.0	131.2	714-1358
III	47	CBA	224.4	18.4	199-270	1045.8	105.6	829-1271
Total Group	141		231.6	22.1	196-351	1030.5	137.0	714-1445

TABLE XI
COMPOSITION OF GROUPS: CHILDREN

Group	N			Presenta- tion Order	Age in Months			Intelligence Quotient		
	Male	Female	Total		Mean	S.D.	Range	Mean	S.D.	Range
I	20	19	39	ACB	131.6	12.6	117-184	118.7	18.2	73-156
II	23	18	41	BAC	130.3	7.9	119-164	116.3	19.1	75-156
III	20	21	41	CBA	128.5	5.5	119-149	114.9	14.5	79-140
Total Group	63	58	121		130.2	9.2	117-184	116.6	17.4	73-156

The general unreliability of such differences for both age groups will be seen by reference to Table XII. All of the differences in "intelligence" between the subgroups of both adults and children are extremely unreliable, and only one of the inter-group age differences yields a critical ratio larger than 3.0. This one exception occurs in the case of the difference between the mean ages of the adult subjects taking the presentation orders ACB and CBA. Even in this case, however, the difference is small and barely reliable, the critical ratio being 3.2378. It should also be pointed out that at the age level of college students, a difference of 14 months does not represent as great a difference in developmental status as it would in the case of younger subjects. The groups may therefore be considered equivalent for the purposes of the present experiment. In computing all means and measures of variability throughout Experiment II, both for subgroups and for total or combined groups, the same procedure has been followed as that previously described in Experiment I.

TABLE XII
RELIABILITY OF INTER-GROUP DIFFERENCES IN AGE AND INTELLIGENCE

Subjects	Presenta- tion Orders	Age in Months			Intelligence		
		Differ- ence	$\sigma_{diff.}$	$D/\sigma_{diff.}$	Differ- ence	$\sigma_{diff.}$	$D/\sigma_{diff.}$
Adults	ACB;BAC	7.1	4.8570	1.4618	0.0	27.9285	0.0
	ACB;CBA	14.4	4.4475	3.2378	22.8	26.0576	0.8750
	BAC;CBA	7.3	4.2661	1.7112	22.8	24.4131	0.9340
Children	ACB;BAC	1.3	2.3580	0.5513	2.4	4.1653	0.5762
	ACB;CBA	3.1	2.1886	1.4164	3.8	3.6892	1.0300
	BAC;CBA	1.8	1.5000	1.2000	1.4	3.7443	0.3739

The mean scores and errors on the separate experimental forms for the three presentation orders, as well as the “combined” values, are presented in Tables XIII and XIV for adults and

TABLE XIII
MEAN SCORES AND ERRORS ON SEPARATE FORMS: ADULTS

<i>Presentation Order</i>	<i>Mean Scores</i>			<i>Mean Number of Errors</i>		
	<i>A</i>	<i>B</i>	<i>C</i>	<i>A</i>	<i>B</i>	<i>C</i>
ACB	101.6957	147.0652	147.7608	1.1739	1.9565	1.6739
BAC	139.7708	116.1458	180.0833	1.6667	1.7917	2.5625
CBA	145.5106	129.2340	117.1277	1.6383	1.3830	1.0213
Combined	128.9924	130.8150	148.3239	1.3930	1.7104	1.7526

TABLE XIV
MEAN SCORES AND ERRORS ON SEPARATE FORMS: CHILDREN

<i>Presentation Order</i>	<i>Mean Scores</i>			<i>Mean Number of Errors</i>		
	<i>A</i>	<i>B</i>	<i>C</i>	<i>A</i>	<i>B</i>	<i>C</i>
ACB	98.5128	135.1282	144.6154	14.7179	16.2051	15.8718
BAC	119.8293	87.4146	156.4390	15.2927	14.9756	13.1951
CBA	151.4390	134.0244	113.4634	20.7317	15.8049	12.2927
Combined ...	123.2604	118.8557	138.1729	16.9141	15.6619	13.7865

children, respectively. For both adult and children subjects, it will be seen that Form A, composed of meaningful designs, and Form B, in which these designs were inverted, received approximately the same mean scores, when the three presentation orders were “combined” to eliminate practice. In the case of the adult subjects, Form B was slightly favored, while the reverse was true in the group of children. In both adults and children, this difference between Forms A and B is distinctly unreliable, as will subsequently be pointed out in Table XVI. Form C, on the other hand, consisting of relatively less “compact” and meaningless designs, yields a “combined” mean score which is significantly different from the respective means for Forms A and B in the case of both adult and children subjects. Thus for adults the “combined” mean score on Form C is 148.3239, while the respective

means on Forms A and B are 128.9924 and 130.8150. Likewise, for children the "combined" means on Forms A and B are 123.2604 and 118.8557, respectively, as contrasted with a mean of 138.1729 on Form C. These differences in difficulty between Forms A and C and between Forms B and C are statistically reliable, as will be pointed out in connection with Table XVI.

An analysis of the "combined" number of errors made on each of the three forms fails to reveal any significant trend. As stated in Chapter II, the fact that the errors seemed fairly evenly distributed throughout the three forms, makes any attempted analysis of the slight differences entirely unwarranted. It is interesting to note from Tables XIII and XIV, however, that there is a general though not consistent tendency among both adult and children subjects for the mean number of errors to increase with practice, although this finding would undoubtedly not be true of the percentage of errors. This relationship can be explained on the basis of at least two factors. In the first place, as the subjects became faster with practice, more substitutions were made, thereby affording more chances for error. Secondly, practice resulted in a given degree of memorization of the key, at least on the part of certain subjects, and this factor would also tend to produce more errors, in so far as the subjects attempted to rely on memory rather than direct reference to the key.

In Table XV have been reported the mean differences between the three forms for each of the presentation orders, together with the variability of such differences. These S.D.'s are reported merely for reference purposes. They cannot be used directly as an index of the degree to which the subjects varied in their susceptibility to

TABLE XV
MEAN DIFFERENCES BETWEEN SEPARATE FORMS AND VARIABILITY OF
SUCH DIFFERENCES

<i>Presentation Order</i>	<i>B-A</i>		<i>C-A</i>		<i>C-B</i>	
	<i>Mean</i>	<i>S.D.</i>	<i>Mean</i>	<i>S.D.</i>	<i>Mean</i>	<i>S.D.</i>
<i>Adults</i>						
ACB	45.3696	20.5913	46.0652	19.1050	0.6957	14.1067
BAC	-23.6250	13.4536	40.3125	18.3576	63.9375	26.7955
CBA	-16.2766	17.1756	-28.3830	19.1050	-12.1064	11.8743
<i>Children</i>						
ACB	36.6154	28.6880	46.1026	21.2132	9.4872	22.2711
BAC	-32.4146	30.1496	36.6098	23.9792	69.0244	13.4164
CBA	-17.4146	18.5472	-37.9756	26.9629	-20.5610	20.1742

the differential influence of context, since practice was not eliminated within a single presentation order, as it had largely been in Experiment I.

A statistical evaluation of the mean differences between the "combined" scores made on each of the separate forms is presented in Table XVI. The two S.D.'s and all succeeding double values

TABLE XVI
EVALUATION OF MEAN DIFFERENCES BETWEEN SEPARATE FORMS*

<i>Forms Compared</i>	<i>Mean Difference</i>	<i>S.D. of the Difference</i>	$\sigma_{diff.}$	$D/\sigma_{diff.}$
		<i>Adults</i>		
B-A	1.8226	17.0735	1.4379	1.2675
		35.2987	2.9727	0.6131
C-A	19.3315	18.8559	1.5880	12.1735
		38.6911	3.2584	5.9328
C-B	17.5089	17.5922	1.4815	11.8184
		38.3927	3.2333	5.4152
		<i>Children</i>		
B-A	-4.4047	25.7949	2.3450	1.8783
		40.4722	3.6793	1.1972
C-A	14.9125	24.0518	2.1865	6.8203
		44.7996	4.0727	3.6616
C-B	19.3172	18.6206	1.6928	11.4114
		48.1144	4.3740	4.4164

* The two values reported for each measure are "combined" and "total" values, respectively (Cf. Experiment I).

reported for each mean difference represent what have been termed "combined" and "total" values, respectively, in Experiment I. It will be recalled that the "total" values were computed by lumping all presentation groups into one distribution, thereby yielding a value which is too large, due to the spurious increase in S.D. as a result of differential practice effect; while the "combined" values were obtained by averaging the separate S.D.'s for each presentation group, thereby eliminating practice effects, but spuriously reducing the S.D. and computed S.E. The reader is referred to Experiment I for a more detailed discussion of this matter. Suffice it to say that for both adults and children, the differences between Forms A and B are unreliable by either method of computation, the critical ratios being less than 2.0 in all cases, whereas the differences between Forms A and C and between Forms B and C are highly reliable by both methods, the critical ratios in the two groups of subjects ranging from 3.6616 to 12.1735.

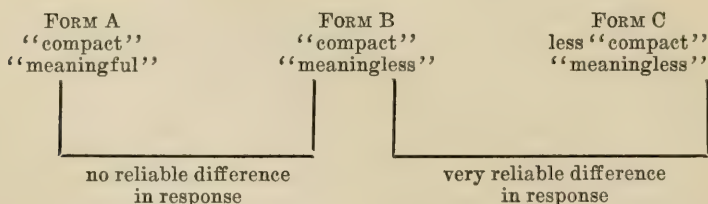
In order further to analyze these differences, an objective index of "compactness" of the designs in each form was obtained, as in Experiment I, by measuring the total contour of the black part of the pattern. In Table XVII will be found the mean contour in

TABLE XVII
RELATIVE "COMPACTNESS" OF MEANINGFUL AND MEANINGLESS DESIGNS

<i>Form</i>	<i>Mean Contour in Inches</i>	<i>Difference</i>	<i>σ_{diff}</i>	<i>D/σ_{diff}</i>
A and B	6.23	1.63	0.2332	6.9897
C	7.86			

inches of the designs in each experimental form, together with an evaluation of the differences. It will be noted that the mean contours of Forms A and B are identical, since the same designs were used in both, but in inverted positions. There is a reliable difference between the mean contours in Forms C and A, and in Forms C and B. In no case was the contour of a design in Forms A or B larger than that of the corresponding design in Form C, and only one design had the same size of contour in all three forms. It is thus apparent that Forms A and B, although differing in conventionalized representation or meaning, did not differ in "compactness." Forms B and C, however, while both relatively meaningless, differed reliably and consistently in "compactness."

For the sake of greater clarity, the characteristics of each form, and the major results obtained with it, are summarized in outline below.



Adequate data have now been presented for an analysis of the factors underlying the differential effect of context obtained in Experiments I and II. Form A, containing "compact" and meaningful designs, was not reliably different in difficulty from Form B, containing equally "compact" but meaningless designs. No difference

in difficulty was found in spite of the difference in conventionalized representative character. Form B, on the other hand, differed reliably in difficulty from Form C, which contained less "compact" although equally meaningless designs. This would seem to indicate that the obtained differences were undoubtedly due to the contextual influence of "compactness."

This fact is further illustrated by an analysis of the scores of those subjects who introspectively reported at the conclusion of the experiment that they observed meaning in certain of the inverted designs of Form B. Of the total group of 141 adult subjects, only 13 reported having seen meaning in this form, 10 of these subjects, as would be expected, having received the forms in the presentation order ACB. Each of the 13, however, reported that such designs did not appear, on the whole, as meaningful as those of Form A. The remaining 128 subjects not only failed to notice that any or all of the designs in Form B were inverted pictures, but expressed astonishment when told after the experiment was over that such was the case. In so far as could be determined, the scores of the 13 adult subjects who reported meaning did not differ noticeably from those of the other subjects. Owing to the small number of cases and to the fact that they were not evenly distributed within the three presentation groups, any specific quantitative comparison is impossible.

Of the 121 children, however, 77 reported meaning in Form B, whereas 44 failed to notice it. At least two chief reasons may be given for the fact that many more children noticed meaning in Form B than adults. The most obvious and important of these reasons undoubtedly lay in the fact that the adults attended very persistently to the problem set for them, whereas the children worked with less concentration and therefore were not so deeply engrossed in the differentiating process. A second reason arises in connection with the writing habits of the subjects. Unlike the adults, the children experienced difficulty in keeping their papers at right angles to the body, with the edges of the sheet parallel to the sides of the desk, as they were instructed. As has been pointed out in the *Procedure*, this undoubtedly resulted from constant training in the Palmer method of writing and, along with the factor of distractibility and lack of sustained interest, probably accounts for the relatively large number of children who reported meaning in the inverted designs of Form B.

A comparison of the scores and errors of the children who reported meaning in Form B with those of the children who did not

is given in Table XVIII. From an analysis of these data it will be seen that the children who reported meaning on this form made slightly lower scores throughout than did those who failed to observe any meaning. This was probably due to the fact that, on the whole, there was a tendency for the more industrious children to concentrate and apply themselves diligently to the task more than the less efficient ones, so that they would make better scores and at the same time be less likely to notice characteristics foreign to the task at

TABLE XVIII

COMPARISON ON CHILDREN'S SCORES AND ERRORS ON THE BASIS OF DIFFERING RESPONSE TO FORM B

<i>Presen- tation Order</i>	<i>N</i>	<i>Mean I.Q.</i>	<i>Mean Scores</i>			<i>Mean Number of Errors</i>		
			<i>A</i>	<i>B</i>	<i>C</i>	<i>A</i>	<i>B</i>	<i>C</i>
<i>Meaning Reported in Form B</i>								
ACB	30	119.9	99.3667	137.6000	146.7333	12.2333	12.0667	10.3333
BAC	23	116.3	110.5217	82.1304	146.4348	17.8696	16.1304	15.6087
CBA	24	115.2	151.0000	133.8750	111.2083	25.0000	16.7500	13.4167
Combined	77	117.1	120.2961	117.8685	134.7921	18.3343	14.9824	13.1196
<i>Meaning Not Reported in Form B</i>								
ACB	9	114.5	95.6667	126.8889	137.5555	23.0000	30.0000	34.3333
BAC	18	116.4	131.7222	94.1667	169.2222	12.0000	13.5000	10.1111
CBA	17	114.6	152.0588	134.3353	116.6471	14.7059	14.4706	10.7059
Combined	44	115.2	126.4826	118.4303	141.1416	16.5686	19.3235	18.3834

hand. Intercomparison shows, however, that there is less of a difference between the groups on Form B than on the other two forms. It is evident that the group perceiving meaning on Form B was not handicapped by this fact. It might even be argued that the children were slightly benefited by awareness of meaning in Form B. This is also shown by the general finding, reported above, that the children as a group did slightly better on Form A than on Form B. This might be attributed to the increased motivational influence of the interest and feeling of familiarity arising from the knowledge that the designs were pictures of real objects. The writer, however, would not wish to place too much emphasis upon this point because of the small, and undoubtedly rather unreliable, differences upon which it is based.

An analysis of the mean scores and number of errors made by adult subjects representing the extremes in intellectual status is presented in Tables XIX and XX. As in Experiment I, the utilization of a correlation technique was impossible, for the reasons

there reported. Thus a procedure involving comparison of scores of groups of differing intellectual level was employed, similar to that described in Experiment I. The 10 adults making the highest and the 10 making the lowest Scholastic Aptitude Test scores within each presentation order were first selected, thus yielding two groups of 30 subjects each in which the differential influence of practice was eliminated. The mean scores and number of errors made by each of these two groups on the three separate forms, together with the mean Scholastic Aptitude Test score of each group, are given in Table XIX. The two groups differ widely in "intelligence" test

TABLE XIX

MEAN SCORES AND ERRORS IN ADULT GROUPS OF DIFFERING INTELLECTUAL LEVEL

<i>Group</i> <i>Form</i>	<i>30 Highest</i>			<i>30 Lowest</i>		
	<i>A</i>	<i>B</i>	<i>C</i>	<i>A</i>	<i>B</i>	<i>C</i>
Mean Score	147.93	144.00	167.47	113.80	115.90	136.03
Mean Number of Errors	0.90	1.43	0.90	1.83	1.87	2.40
Mean Score on Scholastic Aptitude Test	1178.60			890.20		

scores, their means being 1178.60 and 890.20, respectively. This difference is further brought out by the fact that there was no overlapping in Scholastic Aptitude scores between the two groups, the range in the highest group being from 1090 to 1445, and in the lowest from 714 to 973. It will also be seen that the adults making higher "intelligence" test scores make distinctly higher scores on each of the three experimental forms, as was found in Experiment I.

TABLE XX

COMPARISON OF SEPARATE FORMS IN ADULT GROUPS OF DIFFERING INTELLECTUAL LEVEL

<i>Forms Compared</i>	<i>30 Highest</i>		<i>30 Lowest</i>	
	<i>Mean Difference in Score</i>	<i>Mean Difference in Number of Errors</i>	<i>Mean Difference in Score</i>	<i>Mean Difference in Number of Errors</i>
B-A	- 3.93	0.53	2.10	0.04
C-A	19.54	0.0	22.23	0.57
C-B	23.47	- 0.53	20.13	0.53

A comparison of the two adult groups with respect to differences in mean scores and number of errors between the three forms is presented in Table XX. Both groups are affected similarly by context, in that both make decidedly larger scores on Form C as compared with Forms A or B. The amount of difference between scores on the various forms is, furthermore, very similar for both groups. The one noticeable exception appears in a comparison of Forms A and B, in which case it is seen that the group higher in "intelligence" test score is less handicapped by the disturbing influence of the meaningful context of Form A than is the other group. This is evidenced by the fact that the former group of adults yields a B-A difference of -3.93 , while the latter group yields a difference of $+2.10$. One factor which might be advanced to account for this result is the probability that the more "intelligent" subjects were better able to concentrate on the task, which required perceptual analysis rather than synthesis of the experimental material. They were therefore relatively impervious to the disturbing presence of "meaning." No doubt these results would be statistically unreliable, since the small number of cases would increase the size of the S.E.'s. This does not, however, preclude the possibility of there being a true difference, and the evaluation in terms of S.E. would therefore be somewhat misleading in this case. It should be repeated, however, that the major finding of the analysis of the data with respect to "intelligence" indicates no marked differential influence of context upon the two groups.

TABLE XXI

MEAN SCORES AND ERRORS OF CHILDREN OF DIFFERING INTELLECTUAL LEVEL

<i>Group</i> <i>Form</i>	<i>30 Highest</i>			<i>30 Lowest</i>		
	<i>A</i>	<i>B</i>	<i>C</i>	<i>A</i>	<i>B</i>	<i>C</i>
Mean Score	148.97	140.43	165.43	93.50	91.77	109.10
Mean Number of Errors	5.53	6.97	5.37	26.80	17.40	17.17
Mean I.Q.....	136.53			94.07		

An analysis of the corresponding material for children subjects, presented in Tables XXI and XXII, yields the same general results. The groups highest and lowest in "intelligence" score, chosen in the same manner as that previously described for the adult subjects, showed the widely differing mean I.Q.'s of 136.53 and 94.07, respectively. Nor was there any overlapping in I.Q.'s between the two

groups, the respective ranges being from 126 to 156, and from 73 to 111. In agreement with the finding on adult subjects in Experiments I and II, it is seen that the more "intelligent" group of children make distinctly higher scores in perceptual differentiation on each of the three forms. They also make fewer errors on each form, and this difference between the two groups of children in mean number of errors is much more marked than in the case of the adult subjects (*cf.* Table XIX).

TABLE XXII

COMPARISON OF SEPARATE FORMS ON CHILDREN OF DIFFERING INTELLECTUAL LEVEL

<i>Forms Compared</i>	<i>30 Highest</i>		<i>30 Lowest</i>	
	<i>Mean Difference in Score</i>	<i>Mean Difference in Number of Errors</i>	<i>Mean Difference in Score</i>	<i>Mean Difference in Number of Errors</i>
B-A	- 8.54	1.44	- 1.73	- 9.40
C-A	16.46	- 0.16	15.60	- 9.63
C-B	25.00	- 1.60	17.33	- 0.23

Table XXII shows the mean differences in score and number of errors between the various forms made by the two intellectually contrasting groups of children. As in the case of the adults, both groups are affected similarly by context, in that both show distinctly larger scores on Form C than on Forms A or B. As before, there is no outstanding differential influence of context upon the two groups. It is also interesting to note that the more "intelligent" group of children seemed to be less handicapped by the disturbing meaningful context of Form A than were the children of lower intellectual status, as is indicated by B-A differences of -8.54 and -1.73 for the higher and lower groups, respectively. This also agrees with the finding on adults reported above. In general, however, it is seen that, as in the case of the adults, there is no marked differential influence of context upon the two groups.

Use has already been made of certain of the introspections in classifying the subjects on the basis of whether or not meaning was reported in Form B. The remainder of the introspections, however, including in particular the answers to the questions, are invalidated in Experiment II by the differential effect of practice on meaningful and meaningless material within any given presentation order. It

proved impossible for the subjects to allow for this practice effect, since no immediate criterion was available in the individual case. This is shown by the fact that, although instructed to make allowance for the practice effect, the large majority of the subjects reported estimates concerning the relative difficulty of the material which corresponded to the sequence of the forms rather than to the nature of the designs within the given form. As pointed out above, this error was largely, though not entirely, overcome in Experiment I through the additional use of intra-group control. Only rotation or inter-group control was utilized for both adult and children subjects in Experiment II, and thus further consideration of the introspective answers to the various questions does not seem justified.

5. CHECK EXPERIMENT

In order to confirm the finding regarding the effect of "compactness," a final check experiment was performed. The general hypothesis underlying this further analysis was that if "compactness" could, by some simple means, be equated in each of the three experimental forms, the differences in difficulty between such forms should disappear. This was accomplished by inserting horizontal lines between each row of stimulus squares in every design. Black lines were drawn across white spaces, and white lines, across black spaces. These lines, carefully drawn in India inks, were approximately $\frac{1}{2}$ mm. in thickness, and gave the appearance of being printed upon the sheet. It will be recalled that the designs in the three forms differed only in the relative vertical positions of the entire horizontal rows of stimulus squares. Insertion of the horizontal lines would therefore make the contours, or total perimeters, of corresponding designs in the three forms numerically equal. Sample designs from each of the revised forms are presented in Figure VI.

These three modified forms, designated as A', B', and C', were administered to 35 male students at Seth Low Junior College, Columbia University. The group ranged in age from 16 years-11 months to 28 years-3 months, with a mean age of 19 years-9 months. Exactly the same procedure was followed as in the main part of Experiment II. The group was divided into three subgroups of 12, 12, and 11 subjects, respectively, each of which received the three sheets in a different presentation order. The data for these groups, as well as the "combined" results free from practice effect, are presented in Table XXIII. It will be readily seen that there are no significant differences in mean score between any

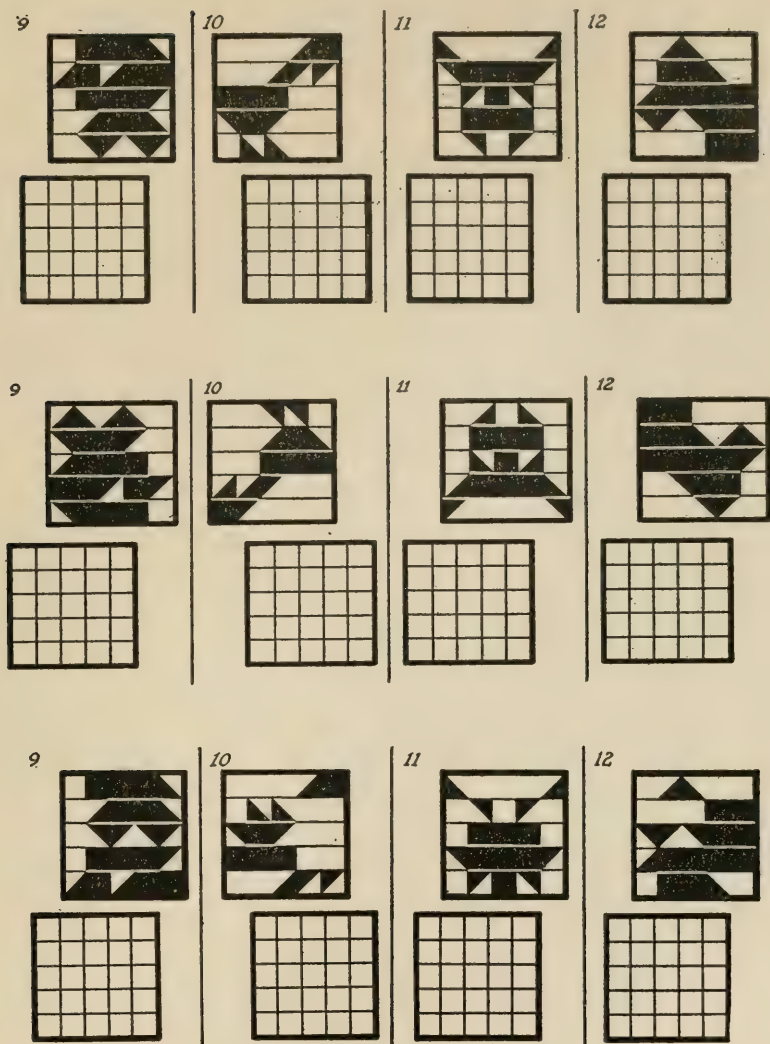


FIGURE VI
Sample designs from Forms A', B', and C' used in Check Experiment
(Reduced to 56% of original size)

of the three forms. As before, the errors show no consistent trend. This was to be expected in view of the small number of subjects making errors, as well as the small number of errors made.

In the introspections, the same questions were asked as in the preceding experiments, with special emphasis upon any other spontaneous reports which the subjects might be able to offer. The

TABLE XXIII

CHECK EXPERIMENT ON THE INFLUENCE OF "COMPACTNESS"

<i>Presentation Order</i>	<i>N</i>	<i>Age in Months</i>		<i>Mean Scores</i>			<i>Mean Number of Errors</i>		
		<i>Mean</i>	<i>Range</i>	<i>A'</i>	<i>B'</i>	<i>C'</i>	<i>A'</i>	<i>B'</i>	<i>C'</i>
ACB	12	233.25	214-255	119.08	175.75	158.00	0.67	1.50	1.75
BAC	12	237.33	210-294	146.33	113.83	158.08	1.25	0.33	1.92
CBA	11	239.45	203-339	162.73	134.55	106.73	2.36	1.09	3.09
Combined	35	236.60	203-339	142.71	141.38	140.94	1.43	0.97	2.25

general trend of these introspections confirmed the objective findings. Of the 35 subjects, 24 individuals, equally distributed throughout the three presentation orders, reported no difference in difficulty between the three forms. The meaningful Form A' was reported more difficult by 5 subjects, whereas 6 stated that the meaningless Forms B' and C' were slightly more difficult. Nor did the introspections indicate any trend toward a difference in difficulty between Forms B' and C'. No subject reported differences between the three forms in what has here been termed "compactness." Only 2 individuals saw meaning in Form B', and only one of these noticed that all of the designs were inverted. The subjects unanimously reported that Form A' was meaningful, which indicates that the horizontal lines equating the three forms for "compactness" did not destroy the meaningful nature of Form A'. Many reported, however, that although Form A' was meaningful, the task exacted such a high degree of concentration that the pictorial influence of the entire design was thereby reduced or seemingly eliminated. Typical introspective reports follow:

"In concentrating upon key symbols, the figures in the meaningful sheet have no importance."

"I took little notice of any general shapes because of interest in speed."

"Since we look at the squares individually, we do not look at the figure as a whole, and then it doesn't matter whether the figure is meaningful or not."

This check experiment thus seems clearly to confirm the previous finding. The relative difficulty of perceptual differentiation may be definitely attributed to differences in "compactness" of the stimulus designs employed, rather than to differences in their conventionalized representative nature.

CHAPTER IV

THEORETICAL INTERPRETATIONS

We now come to a theoretical interpretation of the results. It has been clearly shown that meaning in the sense of conventionalized representation and association with named objects did not noticeably influence the relative difficulty of perceptually differentiating the stimulus designs employed. In Experiment II, the inverted and so-called "meaningless" designs of Form B yielded approximately the same scores as the "meaningful" designs of Form A, and each of these scores differed reliably from the score made on the "meaningless" but relatively less "compact" designs of Form C. Thus the effect seemed to be due to difference in the "compactness" of the experimental designs.

This contextual factor of "compactness," however, was not a function of the entire black figure, as would be expected in accordance with orthodox Gestalt theory. The difficulty of differentiating the parts cannot be attributed to the influence of the total figure. The final check experiment clearly shows that it is *not* the total figural impression which impedes this differentiation of parts, but the comparative absence of definite black-white boundaries separating the squares. The total figure is not changed in "effect" by the introduction of the fine horizontal lines in the last part of Experiment II. If the total "configuration" were the factor impeding differentiation, these horizontal lines should not make any appreciable difference in the ease of the subject's task. But the results show clearly that these fine lines remove all the extra difficulty occasioned by the "compact" designs. Although the total figural impression was not obliterated by the horizontal lines, the contextual factors impeding perceptual differentiation were eliminated, thereby experimentally equalizing the three forms in ease or difficulty of differentiation. Thus the factor of "compactness" cannot be ascribed to the influence of the total impression or *Gestalt*. The general conclusion is that the total "configuration," no less than the so-called meaningfulness or pictorial characteristics of the design, is irrelevant for the particular task of this experiment.

The factor of "compactness," described in terms of the relative absence of specific black-white boundaries, might be interpreted

in accordance with any number of theoretical viewpoints. Gestalt psychologists, such as Wertheimer (40, 41), Köhler (30, 31), and Koffka (29), and others (*e.g.*, 42) have stated certain "laws" regarding the configurational organization of such stimulus situations. According to such an orthodox Gestalt viewpoint, the important rôle of "compactness" or adjacency of specific black or white surfaces in determining the difficulty of perceptually differentiating the particular designs might be described in terms of "proximity," "similarity," "continuity," "*prägnanz*," and the like. Not only does this viewpoint fail to take into consideration the fact that the same physical stimulus will elicit widely differing perceptual reactions in subjects of differing reactional biographies, as is evidenced by many of the experiments reported in Chapter I, but it has been experimentally shown in the present investigation that such contextual factors as are operative do not reside in the total pattern.

The writer would suggest an interpretation of the present results based on an attempted analysis of factors or processes which might possibly underlie or "condition" the perceptual responses to such "compact" stimuli. The continual interaction between the organism and stimulus objects would seem to the writer to offer such a possibility, although the scientific proof must necessarily await an experimentally controlled genetic study of the human or infrahuman infant. There can be no question but that practically all of the stimuli to which an organism has been responding since conception are relatively "compact" in a behavioral sense. The book I read, the chair I sit in, the food I eat, have all elicited a particular series of reactions, which have become conditioned to various aspects or partial details of the stimulus situation. Two adjacent black areas, for example, would be more difficult to differentiate perceptually because long experience has familiarized us with innumerable small and "compact" or homogeneous objects, the parts of which have been found to belong together through empirical interaction. Thus the mere fact that the designs of Form B were more "compact" and thus resembled more closely the stimulus objects encountered in the past actually makes them more "meaningful," in a behavioral sense, than the relatively novel and less "compact" designs in Form C. The writer would suggest that this might readily account for the greater difficulty of differentiating such designs as those in Forms A and B.

Such perceptual habits have doubtless been formed at an early stage in behavioral development, and involve such a wide and basic variety of mechanisms that we actually "see" or perceive the similar adjacent surfaces as a global unit, rather than in some other manner. Such reactions are doubtless acquired very early in the ontogenetic cycle, and are dependent upon such almost universally existing stimulus circumstances that they are very often incorrectly regarded as innate, or dependent upon the physical aspects of the stimulus situation. The influence of "compactness" has been so strongly acquired and woven into the very fabric of perceptual behavior that the additional influence of the resemblance of the black-white area to some conventionalized object is relatively negligible so far as the present task is concerned. According to this interpretation, to refrain from considering the life history or biographical implications of such behavior would be to neglect the fundamental characteristic of perceptual reactions and psychological behavior in general.

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CHAPTER V

SUMMARY

The present investigation represents a quantitative, experimental attack upon the influence of context on perceptual differentiation. The experimental literature on this specific problem is very meagre. Previous data have been obtained only indirectly, or inferentially, and have for the most part been extremely subjective in character. The task selected for use in the present study was a form of code substitution, in which by reference to a key the subject was to substitute numbers for small squares composed of simple black-white surfaces. The squares were arranged in various designs or patterns, some "meaningful," being pictures of objects, and others "meaningless," derived in a standard fashion from each corresponding "meaningful" design.

In Experiment I, four forms were employed, each containing 12 designs: Forms A and B, "meaningful" designs, Forms C and D, "meaningless" designs. The subjects consisted of a group of 126 college women divided into two subgroups, one of which took the forms in the order BDCA, the other in the order CABD. These subgroups were equivalent in age and in Scholastic Aptitude Test score. Thus inter-group as well as intra-group controls were introduced to eliminate the large practice effect shown in preliminary experimentation. The combined data of both groups showed a reliably greater number of correct substitutions to have been made within the given time limit in the "meaningless" than in the "meaningful" forms. A comparison of the findings in groups of high and low "intelligence," respectively, showed no difference in the relative difficulty of "meaningful" and "meaningless" forms between the two groups. The objective results were also strikingly corroborated by the subjects' introspective reports.

Experiment II was a more direct and analytical attack upon the specific nature of the contextual influence established in Experiment I. Three forms were prepared: Form A, composed of 16 "meaningful" designs; Form B, consisting of these designs inverted, so as to retain the same degree of "compactness" of black-white pattern without the "meaningful" connotations; and Form C, consisting of these designs disarranged as in Experiment I, thereby being both "meaningless" and relatively less "compact." A group of 141 college women and a group of 121 sixth grade

school children (63 male and 58 female) were used. Each of these groups was divided into three subgroups, receiving the presentation orders ACB, BAC, and CBA, respectively. The three groups were equivalent in age and "intelligence" or scholastic aptitude. With both adults and children, large, reliable differences in number of correct substitutions were found between Forms A and C, but only small, unreliable differences between Forms A and B. Data are also presented which prove that the lack of difference found between Forms A and B cannot be attributed to the fact that some subjects may have recognized the designs in B as inverted pictures of objects and thus been influenced by the "meaningful" context. As in Experiment I, when groups of high and low "intelligence" were compared, no difference was found in the relative difficulty of "meaningful" and "meaningless" forms between the two groups. That the forms differed in "compactness" was demonstrated by the reliably greater mean "contour," or perimeter, of the designs in Form C, as compared with those in Forms A and B.

A further check experiment on the influence of "compactness" was conducted on 35 male college students. All conditions were identical with those in the preceding experiment, except that the contours of the designs in the three forms were equated by drawing black or white horizontal lines between each row of stimulus squares. No significant difference in mean number of correct substitutions was now found on these three modified forms.

It seemed clearly established, therefore, that it was the "compactness" of black-white pattern and not the conventionalized or representative nature of the context which influenced perceptual differentiation. The suggestion was offered that "compactness" is itself probably "meaningful" in a behavioral sense, and is of biographical or experiential origin.

CHAPTER VI

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